



JANUARY, 1955

No. 203

Bulletin

ASTM COMMITTEE WEEK
JANUARY 31—FEBRUARY 4
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What Standards Mean to Us

General Comments and Background by R. J. Painter	41
Specifications from the Consumer Viewpoint by A. W. F. Green	43
A Producer Looks at Standards by A. O. Schaefer	45
Material Standards and the Department of Defense by C. R. Watts	47
Discussion	50
The Precision of Fuel Rating, 1947 to 1953 by R. M. Gooding and R. B. Cleaton	51
The Five Per Cent Salt Spray Test and Its Acetic Acid Modification by W. D. McMaster	62
An Inexpensive Constant-Load Testing Machine by M. E. Clark and O. M. Sidebottom	69

IN THE SOCIETY

ASTM Year in Review	5
Annual Meeting Symposiums Shaping Up	19
Standards Actions	20
New ASTM Publications	22
Nominating Committee	24
25-Year Members	25
Schedule of Meetings	28
District Activities	29
Technical Committee Notes	31
Personals	76
New Members	82
Deaths	84

GENERAL NEWS NOTES

Random Samples	35
National Reactor Testing Station of the AEC	38
The Bookshelf	74
News of Laboratory Supplies and Testing Equipment	86
Other Societies' Meetings	92
Index to Advertisers	96

ASTM Bulletin is indexed regularly by Engineering Index, Inc.

The Society is not responsible, as a body, for the statements and opinions advanced in this publication.

ASTM Bulletin, January 1955. Published eight times a year, January, February, April, May, July, September, October, and December, by the American Society for Testing Materials. Publication Office—20th and Northampton Sts., Easton, Pa. Editorial and advertising offices at the headquarters of the Society, 1916 Race St., Philadelphia 3, Pa. Subscriptions, United States and possessions, one year, \$2.75; two years, \$4.75; three years, \$6.50; Canada, one year, \$3.25; two years, \$5.75; three years, \$8.00. Other countries, one year, \$3.75; two years, \$6.75; three years, \$9.50. Single Copies—50 cents. Number 203. Entered as second class matter, April 8, 1940, at the post office at Easton, Pa., under the act of March 3, 1879. Copyrighted 1955, by the American Society for Testing Materials.



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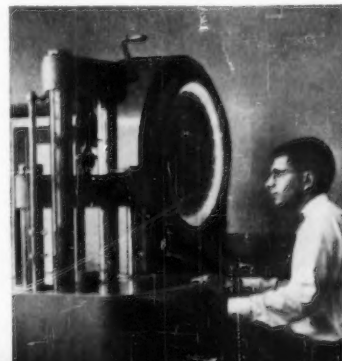
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ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

Number 203

JANUARY, 1955

1954 in Retrospect

A Very Active Year in Technical Activities with Particular Emphasis on Research

STANDARDIZATION and research—research and standardization, these are the two important phases of the Society's work and are so intimately related as to make it impossible to say which has the primary place. Research needs standard methods of test and evaluation. Standardization needs the results of research in arriving at the best test procedures and specification requirements. During the Year 1954 it would be difficult to choose between the two—if anything, more consideration has been given to research than to standardization *per se*. This covers not only the formally sponsored researches such as the program on testing of full size poles sponsored by Committee D-7 on Wood, the extensive corrosion programs under the auspices of the Advisory Committee on Corrosion carried out through the individual corrosion committees, or the research work being carried out under Committee C-16 on the effect of moisture on thermal insulation, but more particularly to the every-day round-robin and group tests carried out by the various committees in the establishment and refinement of satisfactory test procedures.

Much of the technical work of the Society is marked by an ever increasing interest in the statistical approach with respect to sampling procedures, analysis of data, and in laying out research programs. This was emphasized by having the Edgar Marburg Lecture on the subject of "Interpretation of Scientific and Engineering Data" by Dr. H. F. Dodge of Bell Telephone Laboratories, an outstanding authority on the subject. Apart from this, however, many discussions were held in the individual committees on various aspects of the use of statistical analysis, particularly with respect to sampling. In fact, one of the symposiums sponsored at the Annual Meeting dealt with this very subject—the Symposium on Coal Sampling. Committee E-11 on Quality Control,

the leader in all of these considerations, issued the Tentative Recommended Practice for the Probability Sampling of Materials.

Standardization

No new separate technical committees were established during the year but many new standardization projects were undertaken in the individual technical committees. Possibly of outstanding interest was the establishment of new subcommittees on plastic pipe and reinforced plastics in Committee D-20, but many other instances might be cited such as the undertaking of work on colorless waterproofing compounds in Committee C-15, work on caulking compounds in Committee D-1, and work on chain in Committee A-1 on Steel. All of these point up the fact that our committees are ever on the alert in rounding out the standardization programs, and in particular in the past year it would appear that the committees have been especially concerned in the refinement of test procedures and in the study of the meaning of the test procedures that have been standardized in order to know how they contribute to the better knowledge of the properties of materials. Some few have been actively at work on formalized discussions of the significance of tests and the properties of materials determined by them, as for example, Committees D-2 and C-9. The record with respect to the work of the committees is briefed below, recognizing that in many instances reference should be made to the Annual Reports of the committees and to statements concerning their activities that have appeared in the ASTM BULLETIN throughout the year.

Symposiums

The symposiums held at the Annual Meeting are one of the important means of assembling data and the results of research work, supplemented by the

technical papers offered individually. The number of sessions devoted to symposiums compares favorably with previous years and has resulted in important publications such as the Symposium on Effect of Cyclic Heating and Stressing on Metals at Elevated Temperatures; Permeability of Soils; and Methods of Testing Building Construction. An important innovation so far as ASTM is concerned was the Symposium on Odor held at the Annual Meeting. This brings to the fore a subject which was of interest to a number of individual technical committees and lays the groundwork for further work in this field.

The Symposium on Temperature Stability of Electrical Insulating Materials was particularly timely in view of discussions that have been taking place internationally on this subject. The symposium volume was completed in time for distribution at the time of the meeting of the International Electrotechnical Commission in session in Philadelphia for its Fiftieth Anniversary. Two additional papers on the lateral testing of piles were presented at this annual meeting which represent a volume addition to the Symposium subject held in 1953. They are being published as a supplement to the Symposium volume.

Fatigue

Fatigue properties of materials are assuming ever-increasing importance, particularly in the transportation field. During the past years, the Society has continued to have presented before it outstanding papers dealing with new concepts and presenting new data. The Gillett Lecture by Templin was a very thoroughgoing analysis of our present knowledge on fatigue of metals.

Publications

1954 looms large in publications. In addition to having the current material

put in type for publication, there still remained for publication several symposiums from the 1953 Annual Meeting. One of these, the Symposium on Effect of Temperature on the Brittle Behavior of Metals with Particular Reference to Low Temperatures was a particularly comprehensive and correspondingly large publication.

To an increasing extent, papers are published in the ASTM BULLETIN. These papers are largely of the nature of descriptions of new testing apparatus or procedures. A group of papers of a somewhat different nature, however, is being set forth in the pages of the current issue—What Standards Mean to Us.

There have been more than the usual number of compilations of standards, since there is an ever increasing demand for having standards in a specific field available in this convenient form. They are particularly useful in one of the intervening years—such as 1954—between the appearance of the Book of Standards, when supplements only are published. These Supplements of themselves, however, are sizable publications.

Technical Committees

BRIEF statements of the accomplishments of the technical committees of the Society in 1954 follow. These are arranged in the order of the numeric designation of the committees.

A-1 Steel

For some years the Office of Defense Mobilization, working in conjunction with both the American Welding Society and ASTM, has been seeking a way to reduce the cost of welding quality steel under Federal Specification QQ-S-741. In January, 1953, the Federal Supply Service of the General Services Administration published QQ-S-00741 as a proposed revision of QQ-S-741. The new specification is a radical departure from the old Federal Specification in that basic requirements for manufacture and testing now conform to ASTM Specifications A 6 and A 7, which substantially reduces mill extras and will result in large monetary saving to the Federal Government. The Conference Committee of the AWS Bridge Committee in May, 1953, adopted the same basic requirements of QQ-S-00741 in the AWS Specification for Steel for Welded Bridges. Early in 1954 ASTM Tentative Specification A 373 for Structural Steel for Welding was approved by the Society for publication.

Late in 1953 the Society was informed, by the ASA Sectional Committee B31 which originates the American Standard

Code for Pressure Piping, that the gas industry had need for a specification covering high-quality fusion-welded piping in 16-in. diameter and larger for use in high-pressure gas service.

After a year's intensive work in ASTM committees, the Tentative Specifications A 381 for Metal-Arc Welded Steel Pipe for High-Pressure Transmission Service was published late in 1954. It is expected that Section 8 on Gas Transmission and Distribution Piping of the Code for Pressure Piping will include reference to this specification.

For several years the subject of ASTM specifications for alloy steel chain has been under consideration. Finally, in 1954, Committee A-1 a new Subcommittee XXVII on Steel Chain was established, the first item of business of which will be the development of specifications for alloy steel chain.

A-2 Wrought Iron

About ten years ago it appeared as though the wrought iron industry had reached a stage of lethargy. However it now appears as though a rejuvenation has set in. Marketed recently for the first time was cold-drawn wrought iron tubing manufactured to precise tolerances for installation in heat-transfer apparatus and air conditioning systems. In 1954 the ASTM Committee A-2 on Wrought Iron began to gather data as the basis for specifications for cold-drawn wrought-iron heat exchanger and condenser tubing. This will be the first new ASTM specification on wrought iron promulgated since 1937.

A-3 Cast Iron

The first meeting of a newly formed Subcommittee XXVI on Low-Temperature Properties of Cast Iron was held in 1954. Although the impact strength of cast iron is low in comparison with that of ductile metals, it has nevertheless proved very satisfactory in compressors and similar equipment operating at temperatures of -100°F . The impact strength of cast iron will drop about 25 per cent from room temperatures to -100°F . Although specifications for cast iron for low-temperature applications appear desirable, more data are needed.

A-5 Corrosion of Iron and Steel

While no new tentatives were sponsored by this committee during the past year, it is of interest that the biennial report of Subcommittee XIV on Inspection of Black and Galvanized Sheets presented in detail the results of the inspections made in 1953 and 1954. Some of these sheet tests have been on exposure since 1916.

Also appended to the report of Committee A-5 is an interim report of Subcommittee XV on Atmospheric Tests of Wire and Wire Products.

A-6 Magnetic Properties

Achievements of Committee A-6 during the past year, in addition to sponsoring a tentative revision of the Standard General Specifications for Flat-Rolled Electrical Steel (A 345), included the issuance of two new tentatives for electrical steels containing varying amounts of silicon. These were the Tentative Specifications for Flat-Rolled Grain-Oriented Steel, 3 per cent Silicon Content, in Cut Lengths or Coils (A 378) and the Tentative Specifications for Flat-Rolled Electrical Steel, 3.5 to 5 per cent Silicon Content, in Cut Lengths or Coils (A 379).

A-10 Iron-Chromium, Iron-Chromium Nickel, and Related Alloys

Subcommittee XII on Super-Strength Alloys has completed a compilation giving the chemical composition and mechanical properties of the majority of the "super-strength alloys" now in use. It is anticipated that this important work will be made available by the Society as a separate technical publication.

Filling a needed place in industry is the Tentative Recommended Practice for Descaling and Cleaning Stainless Steel Surfaces (A 380), which was sponsored by Committee A-10 and approved by the Society at the Annual Meeting.

B-1 Wires for Electrical Conductors

After several years of discussion of the subject of direction of lay of aluminum stranded conductors, the attempt to establish right-hand lay for all classes was abandoned. Specifications B 231 for concentric-lay-stranded aluminum conductors were revised in 1954 to include the final solution to this problem, which specifies right-hand lay for classes AA and A and left hand for others. Conductors intended for further fabrication into tree wire, or to be insulated and laid helically with or around aluminum or ACSR messengers, are regarded as class A conductors with respect to direction of lay. New conductor sizes and strandings were also added to Specifications B 231. Both the subject of lay and additional sizes and strandings were discussed fully with the appropriate committees of the Edison Electric Inst. before action was taken in ASTM.

With the rapid growth of the electronics industry there has been increasing usage of small insulated conductors specially suited for this application. However there has been no uniformity of specification requirements among the

various groups of users, including the Military. ASTM Committee B-1 recognized the need for standardization efforts in this field about two years ago and has been developing a proposed specification in cooperation with various interested groups, including the Radio-Electronics-Television Manufacturers' Assn., the Military, and producers of the product who were not previously represented on Committee B-1. As a result of this work, in 1954 the Society approved for publication the Tentative Specifications for Soft or Annealed Coated Copper Conductors for Use in Hookup Wire for Electronic Equipment (B 286).

B-3 Corrosion of Non-Ferrous Metals and Alloys

At least a partial solution of the highly controversial salt-spray test has been reached by Subcommittee III on Spray Test. Round-robin tests in this subcommittee have shown that an acetic-acid modification of the salt spray test results in a shorter time for failure and accordingly the Tentative Method of Acetic Acid-Salt Spray (Fog Test) (B 287) was approved by the committee and subsequently by the Society. In addition the present salt spray test (B 117) has been modified by reducing the salt concentration from 20 per cent to 5 per cent.

A paper by W. B. McMaster of General Motors Corp. furnishing the substantiating data for acceptance of the acetic acid modification of the salt spray test will be found elsewhere in this BULLETIN.*

B-4 Metals for Electrical Heating, Electrical Resistance, and Electronic Applications

Subcommittee VIII on Metallic Materials for Radio Tubes and Incandescent Lamps has retained its high rate of activity during the past year in submitting to the Society three tentative specifications of interest to the electronics field. These are the Tentative Specifications for Tungsten Wire Under 20 mils in Diameter (B 288), Tentative Specifications for Molybdenum Wire Under 20 mils in Diameter (B 289), and Tentative Specifications for Round Wire for Use as Electronic Tube Grid Laterals and Verticals (B 290).

B-5 Copper and Copper Alloys

After a long process of circularizing the industry to establish the need for a standard set of requirements for nickel-tin bronze castings, Committee B-5 began to develop such specifications several years ago. As a result the

Tentative Specification for Nickel-Tin Bronze Castings (B 292) was published. Two compositions are included, one of which can be heat treated. The other alloy is a leaded composition. Castings of these alloys are used for constructional or pressure purposes such as machinery frames, gears, cams, switch gear, electric line hardware, bushings, pumps, valves, and cylinders. The as-cast compositions have mechanical properties of approximately 40,000 psi minimum tensile strength; 20,000 psi minimum yield strength; and 20 per cent elongation in 2 in. The heat-treated composition results in 75,000 psi minimum tensile strength; 50,000 psi minimum yield strength; and 5 per cent elongation.

Another particularly significant development was the publication of the Tentative Specification for Copper-Zinc-Manganese Alloy (Manganese Brass) Sheet and Strip (B 291). The chief use of this alloy is for requirements where electric resistance welding is employed. An unusual feature of the requirements is the following statement in the specification: "Since the material is used for many purposes where the requirements of the operation used are too particular to be specified by any of the ordinary physical tests, it is frequently advisable to submit samples to the manufacturer and secure an adjustment of anneal or temper to suit the actual operations to which the material is to be subjected."

A very complete picture of the mechanical properties of four nickel-silver alloys in the form of strip (nickel contents of 18, 12, and 10 per cent, and a 12 per cent alloy with high copper) was presented in a paper by G. R. Gohn, J. P. Guerard, and G. J. Herbert of the Bell Telephone Laboratories at the February, 1954, meeting. This paper was appended to the 1954 Report of Committee B-5 to the Society. During World War II, the shortage of nickel made it necessary to restrict markedly the use of nickel silver strip. The Korean conflict repeated the situation. The data in this paper are presented to show one area in which critical nickel can be conserved without any significant engineering sacrifice.

B-7 Light Metals and Alloys Cast and Wrought

The field of light metals (aluminum and magnesium) still being relatively new, numerous revisions are promulgated by the committee every year.

ASTM Year in Review

These revisions are essentially addition of new alloys and occasional modification of mechanical properties of previously listed light metal alloys.

Results of the atmospheric exposure tests of 30 aluminum and 8 magnesium alloys at New York City and State College, Pa., for 2 yr, Kure Beach, N. C., for 1½ yr, and Point Reyes, Calif., for 1 yr are appended to the B-7 report in a paper* by L. H. Adam and Marie Dougherty.

B-8 Electrodeposited Metallic Coatings

An investigation has been completed, the objects of which were:

1. To determine the relationship between salt spray resistance and thickness of coating, and
2. To determine the degree of reproducibility of salt spray test results for coatings prepared to the same thickness requirements by several producers and tested by several laboratories in conformance with the salt spray test (B 117).

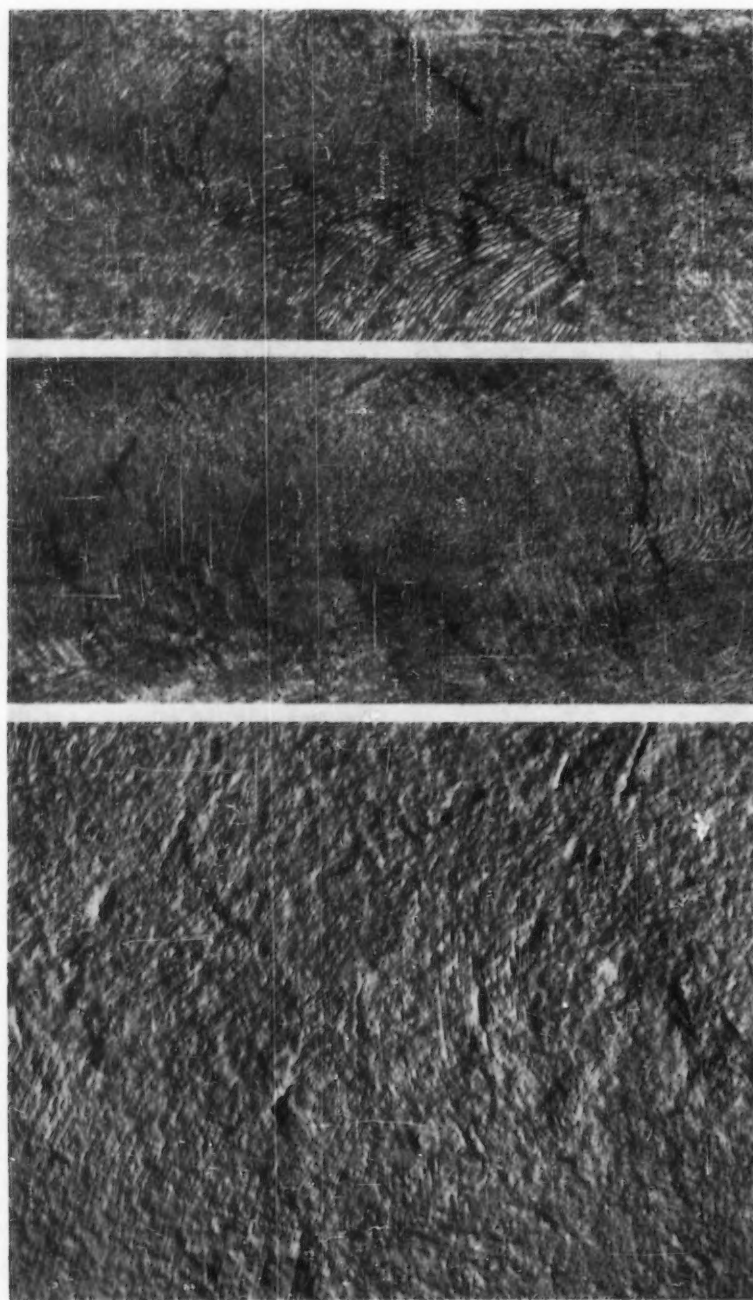
The conclusions reached in this "Report of Section B on Porosity Tests" of Subcommittee III on Conformance Tests are that the salt spray test "does not reliably and reproducibly prognosticate the quality of the finishes under consideration. Its value as a standard acceptance test is questionable in view of the wide divergence of test results obtained on specimens presumably plated to the same thickness by the same plater and tested by the same laboratory." This report is appended to the 1954 annual report of Committee B-8.

B-9 Metal Powders and Products

Although particle-size analysis and fractionation of granular metal powders in the subsieve size range using gas or air elutriation has been used industrially for many years, no over-all industrial procedure had been established for the process. After a great deal of discussion, the Tentative Method for Subsieve Analysis of Granular Metal Powders by Air Classification (B 293) was finally approved. The method is strictly accurate for solid spherical particles of a limited size range and becomes progressively less accurate with

* See p. 62.

* L. H. Adam and Marie Dougherty, "Atmospheric Exposure of Aluminum and Magnesium Cast and Permanent Mold Castings," *Proceedings, Am. Soc. Testing Mats.*, Vol. 54, p. 270 (1954).



Photomicrograph of Surface Deterioration Present on Failed Turbine Nozzle Vane ($\times 20$). Reduced for publication. First Prize, Macrographs—Ferrous, Ninth ASTM Photographic Exhibit. Charles A. Fournier, Ford Motor Co., Dearborn, Mich. Photograph shows that slip has occurred along the crystallographic planes of the individual grains. General rupturing of the grains has occurred at the grain boundary interfaces. The foregoing considerations are offered as evidence of a typical stress rupture or thermal shock failure. Top and second photographs are of the leading edge of airfoil; bottom photograph shows curved surface of the airfoil.

increasing particle diameter, with increasing departure from spherical shape, or with increasing porosity. Precision of the method (as defined by its reproducibility), however, is not decreased with increasing particle size or with departure of the particles from solid, spherical form.

A Tentative Recommended Practice for Hardness Testing of Cemented Carbides (B 294) is intended to serve as a standardizing medium in the cemented carbide industry. Details of specimen preparation, including the method for mounted carbides, are covered in this document.

Joint Committee on Effect of Temperature on the Properties of Metals

The ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals sponsored at the 1953 Annual Meeting what is probably one of the most important symposiums to be presented before the Society. This "Symposium on Effect of Temperature on the Brittle Behavior of Metals With Particular Reference to Low Temperatures" containing 27 papers has now been issued as *ASTM STP No. 158*. It is the belief of the committee that the symposium comprises one of the most comprehensive and authoritative presentations of this complex but very timely subject. This past year the committee sponsored the "Symposium on Effect of Cyclic Heating and Stressing on Methods at Elevated Temperatures."

In addition to this symposium at the ASTM Annual Meeting, the Joint Committee sponsored during the ASME meeting in New York a session on the elevated temperature properties of materials.

C-1 Cement

A proposed specification for slag cement was completed by Committee C-1, subject to letter ballot, representing an extensive study and review of data on this type of cement. Slag cement, although used in certain sections of the country for many years, has never been included as an ASTM standard. Another valuable contribution has been the completion of a comprehensive investigation of the effect of mechanical mixing of mortars which showed a tendency toward higher strengths in nonair-entraining portland cements than is obtained by hand mixing. This will result in a reappraisal of the strength requirements for portland cement (C 150) and for air-entraining portland cement (C 175). A nation-wide survey was accomplished among 63 manufacturers of portland cement and 16 consumer testing agencies whereby all compressive

and tensile strength test data were collected for the first eight months' period of 1954.

Much was accomplished in further revision and refinement of existing test methods, as well as on new projects. An establishment of criteria on false set was further advanced through the preparation of a proposed test method, which has been circulated to the committee. The methods for the determination of air content have been studied in the interest of refinement and improvement of the qualifications. It was announced that standard samples of portland cement will now be available for those interested in chemical analysis of cement through the Portland Cement Assn.

Two new tentative methods were developed and accepted by the Society on hydraulic cement mortars. One method outlines the procedure for determining flexural strength, with the second method using portions of the beams broken in the flexural strength test for determining compressive strength.

C-2 Magnesium Oxychloride and Magnesium Oxy sulfate Cements

Attention during the year was directed mainly toward the development of a method of test to determine wear resistance of oxychloride cement compositions. The shear strength of bonding media test and a means of determining water resistance of magnesium oxychloride cements also received attention by the committee. The development of definitions of terms has been under way.

C-3 Chemical-Resistant Mortars

The determination of bond strength between chemical-resistant mortars and designated chemical-resistant brick is now incorporated into an ASTM tentative as a result of the completion of a proposed method by Committee C-3 on Chemical-Resistant Mortars. This is an important property in establishing the quality of this special type mortar. A series of tests was inaugurated during the year on the determination of tensile, compressive, and bond strength of silicate mortars. Tests were also started to determine reliability of methods used in determining the properties of resin mortars.

C-4 Clay Pipe

The activities of this committee were confined chiefly to the study of the present specifications, particularly in terms of amending the crushing strengths based upon more complete engineering data.

C-7 Lime

In addition to a review of existing specifications, particularly for the chemical industry, Committee C-7 formed a new subcommittee to be responsible for the development of standards covering pozzolanic materials as used with lime products. A study was completed on the lime requirements for silica brick manufacture.

C-8 Refractories

Significant contributions to the knowledge on granular refractory materials were made during the year by Committee C-8. A new test method, in the form of a boiling test for bulk density of granular refractory materials, was accepted, subject to a committee letter ballot. A group of four classifications was completed on basic granular refractories with test requirements. A specification was also prepared, which has been referred to the Subcommittee on Specifications for review.

Additional industrial surveys were prepared and approach completion covering clay linings, installation of refractories, and carbon black furnaces. An industrial survey on refractory service conditions in open-hearth and bessemer hot metal mixers was completed and will be included in the next edition of the Committee C-8 Manual. Special refractories received considerable attention through joint activities with the Special Refractories Assn. The preparation of a load test, thermal conductivity test, and a classification of mullite and silicon carbide refractories is well under way.

C-9 Concrete and Concrete Aggregates

A much needed specification for fly ash for use as an admixture in concrete was completed by Committee C-9 and is now an ASTM tentative. This specification is based on very comprehensive test data secured over a number of years. A companion method of test previously published (C 311), was also extensively revised in order to conform to the new specification. During the years, two new methods for determining volume change were accepted by the Society, one being a test for providing a routine procedure for determining the volume changes of concrete products; the other, a procedure for determining the potential expansion of cement-aggregate combinations.

A new project, the development of standards in the field of packaged, dry,

ASTM Year in Review

pre-mixed materials for mortars and concrete, was advanced considerably with the organization of a subcommittee which has already reviewed an initial draft of a specification. The study of elastic and plastic properties of concrete, another new project, progressed to the point of a decision to develop an extensive bibliography on the subject of creep. A third new project, pore characteristics of aggregates, received initial consideration, with respect to the various ways whereby these characteristics affect aggregate performance.

Extensive data were reviewed on sulfur capping mixtures in a study to determine the effect on concrete cylinder strengths due to different capping mixtures. Extensive revisions were adopted for immediate inclusion in the existing Standard Specifications for Ready-Mixed Concrete (C 94).

C-11 Gypsum

In keeping with the development of new practices in building construction, Committee C-11 completed a specification for gypsum concrete (C 317), which is intended for use in the construction of poured-in-place roof decks or slabs. Extensive revisions were also made in the Standard Specifications for Gypsum Wall Board (C 36), the Standard Specifications for Gypsum Lath (C 37), and the Standard Methods of Testing Gypsum and Gypsum Products (C 26). The problems of mold resistance of gypsum wall board and formboard papers, the characteristics of the paper used for these products, and specifications for joint tape and adhesive were introduced to the committee during the year and study groups have been formed to investigate them.

C-12 Mortars for Unit Masonry

Significant changes were made by Committee C-12 in the Specification for Mortar for Unit Masonry (C 270), including a change of designation of the several mortar types. A suggested test method, together with a report of cooperative tests, was published in the September, 1954, issue of the ASTM BULLETIN on the difficult subject of evaluating efflorescence.

C-13 Concrete Pipe

Two specifications for concrete pressure pipe were completed by Committee C-13, representing the first specifications in the pressure pipe field developed by the committee. One specification is

for low-head reinforced-concrete pressure pipe, intended for use in the construction of pressure conduits. The second specification is for reinforced-concrete low-head internal pressure sewer pipe up to 60 in. interval diameter, with operating head not exceeding 50 ft. A considerable number of tentative revisions of all the existing specifications for concrete pipe were thoroughly reviewed and consolidated, and action taken for incorporation into the existing specifications. One of the important revisions was the recognition of the use of concrete cores in pipe greater than 72 in. in diameter as a means of testing for absorption and compressive strength. Definite progress has been made in the development of specifications for heavier designs of reinforced-concrete pipe.

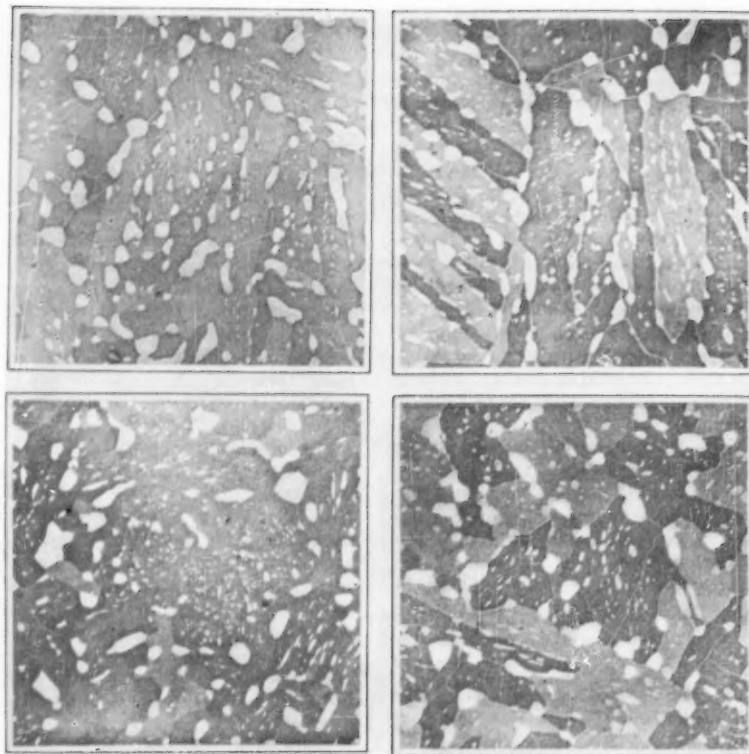
C-14 Glass and Glass Products

Three methods for determining physical properties of glass have now been accepted by the Society, representing one of the major accomplishments of Committee C-14 during the year. These methods determine annealing and strain points (C 336), average linear expansion (C 337), and softening point (C 338). Colorimetric procedures for determining aluminum oxide, titanium dioxide, chromic oxide, and ferric oxide were considered during the year and are approaching completion. The use of the versene titration procedure in the chemical analysis of glass was developed. A new project was inaugurated to study the need for standards on fiber glass, particularly in connection with chemical durability.

C-15 Manufactured Masonry Units

Organization of a subcommittee to develop standards in the field of waterproofing materials for unit masonry walls was completed during the year by Committee C-15. A study group was also formed to consider the need for specifications covering various types of floor brick, including packing house brick.

A proposed tentative specification for brick-block units, made from clay or shale, was referred back to the responsible subcommittee for further study because of suggestions that have been received for desirable changes. A revision was completed of the Standard Method of Sampling and Testing Concrete Masonry Units (C 140), setting up two alternate capping procedures, one being the cement-gypsum capping and the other a sulfur-filler capping. Extensive revisions of the Tentative Specifications for Drain Tile (C 4) were completed by the committee and accepted by the Society. These changes include recognition of the use of air-entraining



Electron Micrograph of Ferrite Grain Structure of Tempered Bainite ($\times 10,000$). Reduced for publication. Second prize, Electron Micrographs—Ferrous. Ninth ASTM Photographic Exhibit. T. R. McKinney, General Motors Corp., Detroit, Mich. The specimen was mechanically polished; left-hand micrographs were etched in 4 per cent picral, right-hand micrographs in 2 per cent nital. A cast Formvar negative was used shadowed at 27 deg. Under the electron microscope, bainite isothermally transformed at 500 F (top) and 750 F (bottom) after prolonged tempering at 1250 F exhibits a ferrite grain structure that is a vestige of the original bainite. This structure is developed by picral (left) and nital (right) etchants, but is better delineated by nital.

portland cement (C 175) and portland blast-furnace slag cement (C 205); limitation of the appeal from the absorption test to clay tile; and minor changes in the description of test specimens, the freezing-and-thawing procedure, and method of determining failure.

C-16 Thermal Insulating Materials

Committee C-16 was very productive during the year in the completion of proposed specifications for several types of thermal insulating materials. Diatomaceous earth insulation in both the block and pipe form (C 333 and C 334), calcium silicate insulation in block and pipe form (C 344 and C 345), cellular glass insulating block (C 343) and cork board insulation for pipe are included in the group of specifications which have been accepted or presented to the Society. A specification for cellular glass pipe covering was advanced to the final stages. A new method for determining conductivity of pipe insulation (C 335) was accepted by the Society, thus rounding out the coverage in measuring ther-

mal conductivity, which includes the guarded hot plate method (C 177) and the guarded hot box method (C 236).

Additional methods for measuring properties of thermal insulating cement were completed, these being the determination of compressive strength and of adhesion. Test data were accumulated on a proposed wet adhesion test and a method for measuring plasticity of thermal insulating cements.

Several methods for measuring special thermal properties, which were either completed or in their final stage, pertain to linear shrinkage, maximum use temperature, determination of hot surface performance, and an emissivity test.

There was much activity during the year in the field of other types of thermal insulation, such as structural insulating board, blanket insulation, and loose-fill insulation. New requirements and methods were studied covering thickness, vapor transmission, inclined panel flame test, direct nail withdrawal, lateral nail resistance, moisture content, and density of insulating board.

The research program on effect of moisture on thermal conductivity of insulation being conducted at Pennsylvania State University made significant progress, particularly toward the first objective, that of developing a satisfactory technique. A probe was developed which has proved very satisfactory in conducting investigation.

C-17 Asbestos-Cement Products

The attention of Committee C-17 during the year was devoted to a study of handleability of asbestos cement products and the development of a method of test for organic material in these products.

C-18 Natural Building Stones

The development of specifications for each type of natural building stone progressed slowly due to the need for research work and data which will provide means for establishing proper test methods and criteria.

C-19 Structural Sandwich Constructions

Proposed test methods for determining the properties of both core material and the complete sandwich construction reached varying stages of development by the end of the year in Committee C-19. A compression test of sandwich cores, a core delamination test, and a core thickness test were under development.

Test methods for sandwich construction included an edgewise compression test and a flatwise flexure test, both of which have been resubmitted to subcommittee for final review.

C-20 Acoustical Materials

Significant developments during the year relate to the completion of a test method for measuring sound absorption and a group of procedures for determining structural properties. The tube method for measuring sound absorption will be the first of three methods which the committee will develop, the other two being the reverberation chamber and the box methods. A more complete account of the work of Committee C-20 will be found in the December 1954 issue of the BULLETIN.

The properties of structural hardness, friability, sag, flexural strength, and linear expansion and contraction have been grouped into one proposed standard which is now being submitted to committee ballot.

C-21 Ceramic Whiteware and Similar Material

A group of nine proposed methods of tests were completed and are now being submitted to letter ballot. A detailed account of these methods is given in an

article appearing in the October, 1954, BULLETIN. Several methods were also prepared covering raw materials in the plastic and titanate groups. Two additional methods on whiteware products that were initiated include a procedure for determining the compressive strength of fired whiteware materials at normal temperature and for determining the thermal conductivity.

C-22 Porcelain Enamel

Methods for the measurement of specular gloss (45-deg) for porcelain enamels (C 346) and reflectivity and coefficient of scatter of white porcelain enamels (C 347) were completed by Committee C-22 and accepted by the Society during 1954. A number of proposed methods were advanced to varying stages of completion on both raw materials and on products. Methods on raw materials which approached completion include an analysis of water for mill additions, a torsion test, a fusibility test, and an evaluation of set characteristics of clays. Procedures for measuring gloss, abrasion, thickness, thermal shock, and continuity of coating represent the activities during the year on products. A more detailed account of the work of the committee will be found in the December, 1954, BULLETIN.

D-1 Paint and Related Materials

The first Method of Test for Printing Inks was completed this year covering a procedure for determining the fineness of grind of printing inks which is a measure of the size and prevalence of oversize particles in the ink. A new method was also prepared for Determining the Effect of Household Staining Agents on Applied Nitrocellulose Clear and Pigmented Finishes (D 1308). Another important new method was the Test for Viscosity Reduction Power of Hydrocarbon Solvents (D 1311). Viscosity Reduction Power is the ratio of the viscosity of the resin dispersed in a control hydrocarbon to the viscosity of a dispersion of the same resin at the same concentration in a test hydrocarbon solvent. New Methods for Settling Properties of Traffic Paints During Storage (D 1309) were also issued as tentative. The Tag Open-Cup Flash Point Method for Volatile Solvents, which was published as information for the past two years, was established as tentative under the designation D 1310. This method is based on the Manufacturing Chemists' Assn. Draft for Flash Point Determination of Liquids

for Classification under ICC Regulations by Tagliabue Open Cup. A new set of photographic reference standards for Evaluating Degree of Blistering of Paints (D 714) was also established. There are now 16 photographs of four blister sizes, Nos. 2, 4, 6, and 8, classified according to Few, Medium, Medium-Dense, and Dense blisters.

In view of the extensive and increasing use of latex and emulsion paints, a new subcommittee was established to develop methods of test for these newer protective coatings. Working groups have already been appointed to study tests for washability or scrubability, efflorescence, package stability, and other special methods for exterior emulsion paints. Study is being given to undertaking work on caulking compounds.

D-2 Petroleum Products and Lubricants

Perhaps the most outstanding accomplishment by Committee D-2 was the establishment of the set of ASTM Copper Strip Corrosion Standards (D 130). This set of visual standards is used in evaluating test strips in the detection of the corrosiveness to copper of aviation and automotive gasoline, farm tractor fuels, cleaners (Stoddard) solvent, diesel fuel, fuel oil (distillate), and certain other petroleum products.

In line with the increased use of jet fuels in aircraft, Committee D-2 this year presented four methods covering procedures for Mercaptan Sulfur by Amperimetric Test (D 1323), Smoke Point (D 1322), and two proposed methods, one for Filterability of Jet Fuels, and the other for Mercaptan Sulfur by Potentiometric Titration.

The committee also completed a comprehensive set of tables for selecting ASTM Viscosity Index numbers calculated from kinematic viscosity. These new tables, which comprise some 830 pages, will be available early in 1955.

The first two tentative methods of test of petroleum waxes, developed in cooperation with the Technical Association of Pulp and Paper Industry, were issued. These covered procedures for tensile strength of paraffin wax and needle penetration of petroleum waxes. Two other important methods issued as tentative were the Tests for Hydrocarbon Types in Liquid Petroleum Products (Fluorescent Indicator Adsorption (FIA) Method) (D 1319), and for Sodium in Residual Fuel Oil by Flame Photometer (D 1318). Among the

newer techniques now being used in the evaluation of petroleum is the infrared spectrophotometer. In this connection Committee D-2 submitted as information an extensive proposed method for determining individual hydrocarbons in a C_4 fraction on the basis of infrared absorption at particular spectral positions.

An interesting and comprehensive summary of the extensive activities being carried on by the numerous research divisions and technical committees of Committee D-2 was published in the October, 1954, ASTM BULLETIN, p. 20.

D-3 Gaseous Fuels

A new Tentative Method of Test for Total Sulfur in Fuel Gases (D 1072) was completed by Committee D-3 this year. This test determines total sulfur in combustible fuel gases when present in concentrations between 1.0 and 30 grains of sulfur per 100 cu ft. It is applicable to natural gases, manufactured gases, and mixed gases such as are distributed by gas utility companies. An important revision was made in the Tentative Methods for Measurement of Gaseous Fuel Samples (D 1071) involving the clarification of the procedure for calibration of the 0.1 cu ft wet test meter. Corresponding changes will be made during the coming year in the applicable sections of the Standard Method of Test for Calorific Value of Gaseous Fuels by the Water-Flow Calorimeter (D 900). Steps have been taken to make other changes in Method D900 including probable effects on reproducibility of factors such as temperature, barometric pressure, heating value of the gas, and relative humidity, as well as differentiating between reproducibility of the humidity control and humidity correction methods.

D-4 Road and Paving Materials

Further consolidation and refinement of existing standards represented the principal activity of Committee D-4 during 1954. In several specifications governing the requirements for aggregate used in highway construction, changes were effected which include the adjustment of certain sizes according to practice and the addition of a soundness requirement.

The development of testing methods for measuring stability and flow value of bituminous mixtures was advanced during the year to the point where proposed test procedures covering the Marshall apparatus and the Hveem apparatus were approved for subcommittee ballot. It is proposed to publish these two methods as information only before consideration as ASTM standards. A kneading compaction method for bitu-

minous mixtures, to be used in connection with the Hveem apparatus, was also completed and is now being studied in subcommittee.

The subject of specific gravity of bituminous-coated aggregates was reviewed, with several test procedures being considered. Further data are required to resolve the differences in results from the several methods. A cooperative test program was initiated to develop data on the rolling ball apparatus for measuring the rate of setting of bituminous materials. Test data were secured on viscosity and demulsibility determinations of bituminous emulsions, but more work is required before recommendations can be made. The use of flame photometry to determine the percentage of bituminous coating retained on aggregate after subjection to the static immersion adhesion test was studied, and further consideration to a method has been felt warranted.

An extensive survey was conducted among state highway departments and municipalities on the use of permanent type traffic markers. This information was felt to be insufficient, however, and further survey will be made among producers, together with the development of a cooperative testing program. A proposed tentative method of testing soils for water-soluble constituents was accepted by the Joint D-4-D-18 subcommittee.

D-5 Coal and Coke

Standardization activities initiated in the past year include the moisture-holding capacity of coal and a determination of the fusibility of ash. A revision of the standard method of test for cubic foot weight of crushed bituminous coal (D 291) has been proposed in order to incorporate the most modern method for determining cubic foot weight.

A continuing study of the analytical methods for coal and coke has resulted in additional determinations for the mineral carbon dioxide content of coal. Also the methods for sampling coal have received greater attention as a result of the Symposium on Coal Sampling held at the 1954 Annual Meeting.

D-6 Paper and Paper Products

A major project of this committee is the review and revision of existing test methods. This is a long range project and was initiated in an effort to insure the validity and uniformity of these test methods in the light of more recent information and study.

A first approximation on a specification for kraft paper is in the early stages of study. This specification has had the concerted interest of the committee be-

cause it is the first of its type and detailed complexity to be initiated by Committee D-6.

Completed projects over the past year have been the revision of: Tentative Method of Test for Water Resistance of Paper, Paperboard and Other Sheet Materials by the Dry-Indicator Method (D 779), Tentative Methods of Test for Ply Adhesion of Paper (D 825), and Tentative Methods of Test for Zinc and Cadmium in Paper (D 1224).

D-7 Wood

Three new tentatives were completed by Committee D-7 on Wood and accepted by the Society. One of these, a tentative specification for modified woods (D 1324) is applicable to wood in the form of solid lumber or veneer or an assembly of lumber or veneer the properties of which have been changed by physical or chemical methods. A commercial product in this category is compreg. A specification for ammoniacal copper arsenite (D 1325) and a method of chemical analysis of this material, also known as chemonite (D 1326) adds to the coverage in the wood preservative field.

Important advances were made in the studies of stress grading and working stresses, which will be a basis for an extensive revision of the Methods for Establishing Structural Grades of Lumber (D 245).

Significant progress was made during the year in the actual testing program on wood poles conducted at the Forest Products Laboratory. Two progress reports have been circulated. Full reports have appeared in the April and December issues of the ASTM BULLETIN.

Work in the new activity of the committee on structural fiber boards was initiated during the year, with task groups being given the assignment of developing nomenclature and definitions and to make a survey of existing test methods.

D-8 Bituminous Waterproofing and Roofing Materials

The staining properties of asphalt may now be determined by a new tentative method (D 1328), which was completed by Committee D-8. A new tentative specification for Woven Burlap Fabrics Saturated with Bituminous Substances for Use in Waterproofing (D 1327) was also accepted during the year. The development of methods of tests for determining consistency over the full range of cold-applied roofing materials progressed during the year, using the modified Stormer and a lightweight penetration cone method.

A proposed method for determining

asphalt compatibility was completed in subcommittee and referred to letter ballot of the entire committee. This method is based on the Oliensis test, which has been used in industry for over 20 years. In recognition of this, the new method will be entitled the Oliensis Test for Contact Compatibility of Bituminous Materials.

The newly organized Subcommittee on Rheological Properties initiated its first projects, which basically will be the development of simpler and more rational fundamental test methods for correlating the capabilities of bituminous waterproofing and roofing materials.

D-9 Electrical Insulating Material

Two Symposiums have been sponsored by the committee during the year. The first, held at the annual meeting in June, has been reported in detail and is available in print (Symposium on Temperature Stability of Insulating Materials *STP161*—BULLETIN, September, 1954, p. 21; October, 1954, p. 6). The second on "European Developments in the Testing of Transformer Oil" was held during the Cleveland meeting on November 17 and is reported below.

Activities of the committee during the year have been reported in some detail in various issues of the BULLETIN. Reference is made to reports of action on standards—April, p. 9; July, p. 41; September, p. 12; and December, p. 9. Other reports of activities appeared in the BULLETIN in May (p. 45) and in July (p. 34). A report of the most recent meeting appears in this issue on p. 32.

The specification for shellac (D 784) is being coordinated with a similar specification of Committee D-1 (D 273). Also the American Shellac Assn. is writing a new specification for shellac which will be considered by Committees D-1 and D-9.

Subcommittee III on Plates, Tubes, Rods and Molded Material voted to relinquish joint jurisdiction (with Committee D-20 on Plastics) for test methods for mechanical properties of plastic materials. Test methods affected are D 256, D 790, D 570, and D 494. Committee D-9 will be represented in the future on Subcommittee I on Strength under Committee D-20.

The committee has been active in international standardization and is interested in the work of IEC/TC 15 on Electrical Insulation as well as of ISO/TC 61 on Plastics and other ISO Technical Committees on shellac and mica.

Subcommittee V on Ceramics has been reactivated and will be under the chairmanship of E. J. Smoke of Rutgers University. It was pointed out that Committee D-9 will be concerned only

with electrical properties leaving consideration of mechanical properties to Committee C-21 on Ceramic Whiteware and Similar Products and Committee C-14 on Glass and Glass Products.

D-10 Shipping Containers

Initiated in the past year were the proposed methods of testing load-displacement characteristics, drift and permanent set of package cushioning materials, and a proposed list of tests for interior packing as an outline of future activities.

Continuation of the interlaboratory cooperative tests in an effort to increase the reproducibility of test results between various laboratories, has brought valuable information to light. Upon completion of these tests, revisions of methods and apparatus are expected to enhance the value of the large scale test methods now in use by Committee D-10.

The 1954 revision of the Bibliography on Shock Absorption Studies has been circulated. This new edition includes six new abstracts making a total of 21 abstracted articles.

D-11 Rubber and Rubber-Like Materials

Committee D-11 completed an extensive revision of the large number of individual specifications for rubber-insulated wire and cable used for the distribution of electrical energy. This included a master specification covering construction details, materials, and voltage test requirements. This general specification is referred to in the individual specifications for specific types of insulation, all of which were brought up to date. Included in this program were two new tentative specifications for polyethylene, and for ozone-resisting butyl rubber insulation for wire and cable.

In an effort to standardize testing temperatures, Committee D-11 has prepared a tentative recommended practice for standard test temperatures for rubber and rubber-like materials. From this list of standard test temperatures, selection may be made for any specific test or test method. These several recommendations have been approved by the Administrative Committee on Standards.

The first Specifications for Sheet Rubber Packing (D 1313) were issued as tentative. These specifications cover packing or gaskets cut from sheets which are intended for general gasket

ASTM Year in Review

applications on water, air, and low-pressure steam service lines.

Another new method covers a Test for Evaluating Low-Temperature Characteristics of Rubber and Rubber-Like Materials by a Temperature Retraction Procedure (D 1329). This method describes a procedure for rapid evaluation of crystallization effects and for comparing viscoelastic properties of rubber and rubber-like materials at low temperatures. It is useful when employed in conjunction with other low-temperature tests for selection of materials suitable for low-temperature service. It is also of value in connection with research and development, but is not yet considered sufficiently well established for use in purchase specifications.

Important changes were made in the Tentative Methods for Chemical Analysis of Rubber Products (D 297), including a complete revision of the procedures for determining copper and manganese in rubber.

The Tentative Specifications for Non-Metallic Gasket Materials for General Automotive and Aeronautical Purposes (ASTM D 1170; SAE 90R), which are under the jurisdiction of the joint SAE-ASTM Technical Committee on Automotive Rubber, were revised to include four new grades of rubber composition gaskets and three new grades of treated and untreated paper gaskets. In addition, a number of changes were made in specific values for the present grades of materials covered. Several revisions were also made in the SAE-ASTM Specifications for Rubber and Synthetic Rubber Compounds for Automotive and Aeronautical Applications (ASTM D 735; SAE 10R).

A noteworthy accomplishment of the year was the preparation of a comprehensive "Glossary of Terms Relating to Rubber and Rubber-Like Materials." Suggestions received are now being studied by the originating subcommittee looking toward submission of the glossary to the Society for publication as tentative.

D-12 Soaps and Other Detergents

Methods of Test for Surface and Interfacial Tension of Solutions of Surface-Active Agents (D 1331) were accepted by the Society for publication as tentative. The latest Supplement to the Metal Cleaning Bibliographical abstracts extended the coverage of the Bibliography from 1951 into 1954.

In recognition of the importance of

sampling and interpretation of data, a new D-12 subcommittee was established to cover the over-all coordination of all work on these problems in the committee.

D-13 Textile Materials

The first Methods of Testing Elastic Fabrics (D 1333) were completed by Committee D-13 and issued as tentative. These methods include procedures for testing elastic braids and narrow woven fabrics containing natural or synthetic rubber threads in combination with textile yarns.

Continued activity of the Subcommittee on Cotton Products resulted in the preparation of separate Tentative Methods of Test for Micronaire Finesness of Cotton Fibers (D 1448) and for Length of Cotton Fibers by Fibrograph (D 1447). Also a proposed method for predicting differential dyeing behavior of cotton was published as information.

Two methods for determining the wool content of raw wool were also completed. The first, Method D 1334, covers a commercial scale procedure and

the latter, Method D 584, a laboratory scale method. The Tentative Methods of Core Sampling of Raw Wool in Packages for Determination of Percentage of Clean Wool Fiber Present (D 1060) were revised, as was also the Test for Vegetable Matter in Scoured Wool (D 1113).

A new Method for Tuft Bind Test of Floor Coverings (D 1335) was issued as tentative. This covers procedures for determining the force required to remove completely a tuft of cut pile floor covering or to pull or snag a loop of looped pile floor covering.

In line with the increasing use of the newer synthetic fibers in textile fabrics, the Tentative Methods of Test for Dimensional Changes in Laundering of Fabric Woven Wholly or Partially of Man-Made Organic Base Fibers (D 416) were revised and brought up to date.

As a result of the continuing efforts of the Joint ASTM-AATCC Committee, the Test for Snag Resistance of Hosiery (ASTM D 1115; AATCC 65) and the Test for Color Fastness to Light of Textiles (ASTM 506; AATCC 16) were revised and brought into agreement.

D-14 Adhesives

New procedures for testing the strength of adhesive by peel and strip methods were initiated.

The redesigning of tensile strength joint assembly test methods has been continuing for many years. A discussion of these methods was keynoted at the last meeting of the committee, and redesigning tensile strength assemblies is receiving renewed attention. The methods concerning the susceptibility of adhesives to attack by rats and roaches are now being proposed to the committee for adoption as tentative. Exhaustive experimental work on the reduction of the time of test cycles for marine adhesives is making significant progress despite the great amount of data needed before such changes may be adopted. Projects which have been completed in the past year include the publication of: Tests for Adhesives Relative to Their Use as Electrical Insulation (Tentative) (D 1304), Test for Storage Life by Consistency and Bond Strength (Tentative) (D 1337), and Test for Working Life of Liquid or Paste Adhesives by Consistency and Bond Strength (Tentative) (D 1338).

D-15 Engine Antifreezes

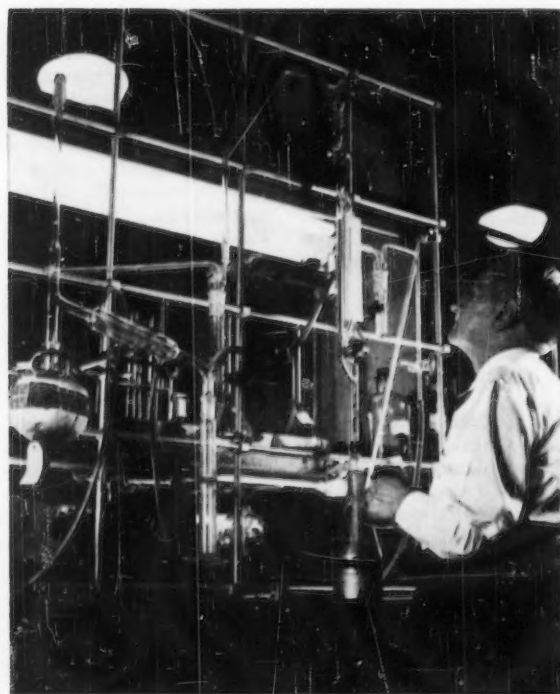
A modification of the suggested procedure for the corrosion test of engine antifreeze was presented at the fall meeting of the committee. This modification represents continued efforts on the part of Subcommittee VI on Simulated and Actual Service Testing, to propose a valid corrosion test which will require a minimum of effort and apparatus.

The interlaboratory testing program on antifreeze corrosion of rubber hose samples is continuing, utilizing the facilities of twelve cooperating laboratories. An extensive study of the analysis of glycols in antifreezes is continuing. This study, though of great interest, is expected to take a great deal of time before completion due to the complexity of the necessary apparatus. However, it is hoped that the study will also uncover a less demanding alternate method which may be used as a control test.

D-16 Industrial Aromatic Hydrocarbons

The use of spectroscopic methods for identifying various homologues of benzene, toluene, and xylene has been initiated. A program to provide a complete series of test methods for defining the properties of naphthalene has been proposed with the initial phases already under way.

The study of a series of thermometers which will adequately cover the ranges of distillation and solidification of aromatic hydrocarbons within the scope of



Vacuum Distillation Apparatus Used in Fuel and Lubricant Analyses. Second Prize, General Photographs. ASTM Ninth Photographic Exhibit. Theodore S. Brinkmann, Baltimore and Ohio Railroad Research Dept., Baltimore, Md.

the committee is approaching completion. Other work actively being followed includes determination of thiophene in aromatic hydrocarbons, the determination of bromine index of potentiometric titration and the correlation of distillation methods under the jurisdiction of committees D-16 and D-1.

D-17 Naval Stores

Work on the crystallization of rosin has been reinitiated. It is hoped that the reawakened interest in this work will bring positive results at an early date. Continuing study of glass standards to supplement the U. S. Official Standards for rosin has received great impetus by the demand, and it is expected that a satisfactory secondary standard may shortly be manufactured to alleviate this situation by enlisting the manufacturers of Lovibond glass testing apparatus.

D-18 Soils for Engineering Purposes

A Symposium on Soil Permeability was sponsored by Committee D-18 in 1954, together with additional papers including two on lateral pile load test, which augment a symposium presented in 1953.

Three well-recognized standard methods of long standing were revised and reverted to tentative status. These methods were the test for liquid limit (D 423), test for plastic limit and plasticity index (D 424), and the mechanical analysis of soils (D 422). A revised version of the Method for Determining Moisture-Density Relations of Soils (D 498) was prepared, but further agreement is necessary before presentation to the committee. Following the earlier presentation of a Symposium on Identification and Classification of Soils, a subcommittee inaugurated in 1954 a program to develop a standard method based on a review of the several systems currently in use by different agencies.

A new section was organized to operate in the field of soil conditioners. The Joint D-4-D-18 Subcommittee presented to Committee D-18 a Proposed Method of Testing Soils for Certain Water Soluble Constituents which has been developed by the Subcommittee on Special and Construction Control Tests.

D-19 Industrial Water

A new edition of the Manual on Industrial Water, including a detailed subject index and all of the current D-19 standards, was published. In addition to a number of revised methods, there were included four new methods of test for Internal Deposits on Tubular Heat Exchange Surfaces (D 1341), Oily Matter in Industrial Waste Water (D 1340), Sulfite Ion in Industrial Water (D 1339),

and Acute Toxicity of Industrial Water to Fresh-Water Fishes (D 1345). Four abbreviated methods for the analysis of water supplies in the evaporative industry, prepared by Committee D-19, have been submitted to the Boiler Code Committee of The American Society of Mechanical Engineers with a recommendation for their inclusion in the ASME Boiler Test Code.

D-20 Plastics

Lending substance to some of the spectacular press agency which has recently heralded certain new plastics applications, the plastics committee during the year has settled down to the prosaic business of working up test methods and writing specifications for some of the newer plastics. Early in the year, the committee organized five new subcommittees on reinforced plastics, plastic pipe (jointly with SPI), thermoplastics, thermosetting resins, and film and sheeting. During meetings in June and in November, these subcommittees have been organized and scopes of sections on specific aspects of the main problems have been decided upon. There is considerable demand for standardization in these fast-growing new fields and the committee clearly recognizes that it has a responsibility to support this growth with sound engineering standards (see *Plastics in Building*, p. 73).

Enlarging the scope of the plastics committee to include certain plastics materials not previously considered has introduced problems of representation from those segments of the plastics industry. A Task Group on Membership has been appointed which will make recommendations to the Advisory Committee.

Activities of the committee during the year have been reported in previous issues of the BULLETIN. Standardization's activities were reported in July (p. 36), and in December (p. 10). Other reports appeared in May (p. 46), July (p. 29), and October (p. 27).

On the international front, the committee was well represented in the American delegation at the meeting of ISO/TC61 at Brighton, England, October 4-8. It has been reported that those present were in accord on a number of items on the agenda, thus indicating real progress toward international understanding in this area. (For a more complete report of International meetings, see p. 21).

ASTM Year in Review

D-21 Wax Polishes and Related Materials

Projects which the committee has initiated in the past year include a study of the flash point of solvent type waxes and a specification for general purpose water-emulsion floor waxes. The committee has continued to refine its published methods and to continue to enlarge its activities to include both solvent-type floor waxes and wax polishes for various types of application.

Work which has been completed and published in the past year includes: Tentative Method of Test for Paraffin-Type Hydrocarbons in Carnauba Wax (D 1342); Proposed Method of Test for Measuring the Static Coefficient of Friction of Waxed Floor Surfaces and Proposed Method of Test for Measuring the Dynamic Coefficient of Friction of Waxed Floor Surfaces, published in the February, 1954, issue of the BULLETIN; and Suggested Method of Test for Concentrating Additives of Waxes and Suggested Method of Test for the Index of Refraction of Carnauba Wax and Other High-Melting Point Natural and Synthetic Waxes, published in the April, 1954, issue of the BULLETIN.

D-22 Atmospheric Sampling and Analysis

"The odorous properties of materials, pleasant, unpleasant, or with mixed cultural associations, stemming from the materials directly, or so distantly removed from them that the odor source is obscure, have been increasingly recognized as being fruitful subjects for study." This quotation is taken from the Symposium on Odor, *ASTM STP No. 164*, and reflects the complexity of the work confronting Committee D-22. The committee, in an effort to clarify some of the misconceptions concerning odor, sponsored a seven-paper Symposium on Odor at the annual meeting.

Other work of the committee during the past year were the completion of a method for sulfur dioxide analysis and a list of terms and definitions used in air sampling. Both of these proposed tentatives are currently being submitted to the Administrative Committee on Standards for approval.

D-23 Cellulose and Cellulose Derivatives

Shortly after the establishment of Committee D-23, a broad program of standardization was instituted which

included studies of cold and hot alkali solubility, color, ash constituents, extractives, pentosans, and other areas of cellulose interest. These subjects are being actively pursued and preliminary reports from this program are anticipated in the near future. Work nearing completion covers two methods measuring the degree of substitution and the viscosity of sodium carboxymethylcellulose, and the method of testing the cellulose acetate butyrate.

Projects which have been completed in the past year include the Tentative Method of Testing for Viscosity of Cellulose Derivatives by Ball-Drop Method (D 1343), Methods of Testing Methylcellulose (D 1347), Methods of

Testing Moisture in Cellulose (D 1348), and Revisions of Specifications and Tests for Soluble Cellulose Nitrate (D 301), and Methods of Testing Cellulose Acetate (D 871).

E-1 Methods of Testing

The outstanding accomplishment by Committee E-1 this year was completion of revisions of the Definitions of Terms Relating to Methods of Mechanical Testing (E 6). The former Standard Definitions E 6 had been published for the past 24 years without change. These definitions are quite widely used and are referred to in standards of many other technical committees. The application of these terms to some of the

newer materials indicated a need to review the definitions in order to bring them up to date. In addition to the basic terms such as stress-strain, tensile strength, yield point, etc., included in the former standard, there have been added new definitions for the terms "True Stress," "Shear Strength," "Brinell, Rockwell, and Diamond Pyramid Hardness Numbers," "Gage Length," "Reduction of Area," and "Indentation Hardness."

There is frequently need for determining quickly the hardness of a metal. Committee E-1 accordingly prepared the new Tentative Method of Rapid Indentation Hardness Testing of Metallic Materials (E 103).

An important addition was made to the Tentative Methods of Testing of Metallic Materials (E 8) in the form of two tension test bars for testing powdered metals. These test specimens were prepared in cooperation with Committee B-9 on Metal Powders and Metal Powder Products.

In cooperation with Committee D-2 on Petroleum Products, there was prepared proposed specifications for apparatus for determination of water by distillation. These specifications cover equipment used in the Standard Method of Test for Water in Petroleum Products and Other Bituminous Materials (D 95).

A new Subcommittee on Microscopy was established by Committee E-1 in response to a need for a technical committee to deal with the problems arising in this rapidly expanding field of testing. The work of this committee will include both light microscopy and electron microscopy. Task groups have been established on Photomicrographic Materials, Microscopes and Their Elements, ASTM Bibliography, and Preparation of Materials.

Committee E-1 completed plans during the year for sponsoring two symposiums at the 1955 Annual Meeting of the Society, one on Impact Testing, and the other on Effect of Speed of Testing of Non-Metallic Materials.

E-3 Chemical Analysis of Metals

The results of the combined efforts of Committee E-3 and Committee B-4, in the form of the new Tentative Photometric Methods for Chemical Analysis of Electronic Nickel (E 107), were accepted for publication. These methods represent the culmination of several years of intensive studies, which are continuing with the purpose of developing additional procedures for analysis of electronic nickel. Also new this year are the Tentative Methods for Chemical Analysis of Copper-Beryllium Alloys (E 106).



Electron Micrograph of Ferroxx and Lubrite Coatings to Prevent Metal Seizing ($\times 25,000$).

Reduced for publication.

Second prize, Electron Micrographs—General Ninth ASTM Photographic Exhibit. D. M. Teague and F. O. Thomas, Chrysler Corp., Detroit, Mich.

E-4 Metallography

The metallographic portion of the Photographic Exhibit at the 1954 Annual Meeting was far larger than any sponsored by Committee E-4 to date. In addition to the general industrial metallographic section, there was a student section and a foreign section. Cash prizes donated by Committee E-4 were awarded to the students. The foreign section included, among many others, special exhibits by Antonia Scortecchi of Istituto Siderurgico, Genoa, Italy, and B. W. Mott, Atomic Energy Research Establishment, Harwell, England.

Subcommittee XI on Electron Microstructure of Steel published its fourth progress report on the relationships between bainitic and martensitic structures, particularly comparing the structures after each had received the same tempering treatment.

A reorganization of Subcommittee XI was approved. Henceforth it will be known as Subcommittee XI on Electron Microstructure of Metals. There will be two subdivisions, one working with electron microstructure of steel, the other with electron microstructure of non-ferrous metals.

E-5 Fire Tests of Materials and Construction

Encouraging results were obtained in the research program conducted at the Forest Products Laboratory on the small tunnel test apparatus under the sponsorship of Committee E-5. The results of this program, which is continuing, will be of interest to several ASTM committees. Further refinements were accomplished in the Standard Methods of Fire Tests of Building Construction and Materials (E 119), including revision of the thermocouple location and the use of the hose stream test.

A complete revision of the Standard Methods of Fire Tests of Door Assemblies (E 152) was drafted, but further review is necessary before presenting a recommendation to the committee. A test method for use in classifying materials as combustible or noncombustible was prepared and presented to the committee. Further study is needed, however, in preparing this method in acceptable form. A much-considered method of fire tests of roof coverings was again reviewed during the year, with definite action deferred until the next meeting of the committee.

E-6 Methods of Testing Building Constructions

During the year cooperative efforts were made between Committee E-6 on Methods of Testing Building Construc-

tion and other ASTM committees interested in materials. A racking test procedure for evaluation of sheet materials, originally prepared by Committee C-16 on Thermal Insulating Materials, was reviewed for inclusion in ASTM Method E 72 which is under the sponsorship of Committee E-6. A draft of a proposed method of test for strength and stiffness of prefabricated floor and roof constructions was reviewed. The evaluation of the properties of materials for heat and water vapor transmission continued during 1954.

E-9 Fatigue

Continuing the practice established four years ago, Committee E-9 prepared again this past year a list of references to articles on fatigue published the previous year (1953). This was issued as *ASTM STP No. 9 E*.

Also following a well-established practice of sponsoring high-caliber papers in

ASTM Year in Review

the field of fatigue, two sessions containing 12 papers were presented at the annual meeting.

E-10 Radioactive Isotopes

Since 1951, its organization year, Committee E-10 has been slowly gathering data in fields which seem fertile for standardization work. In 1953 a very successful symposium was held in Atlantic City. The papers presented were printed in 1954 and are available in the Symposium on Radioactivity—An Introduction (Radioisotopes—Laboratories—Personnel—Radiation—Management Problems—ASTM Work) (*STP 159*).

Also in 1954 the activities of the committee have crystallized. Six subcommittees are under organization including: (1) isotopic application and methods, (2) health and safety, (3) radiation standards and counting techniques, (4) radioisotope gages, (5) tracer methodology, and (6) analytical methods.



Electron Micrograph of Normal Portland Cement Clinker ($\times 5000$).

Reduced for publication. First prize—Foreign Electron Micrographs, Non-metallic. Ninth ASTM Photographic Exhibit. Tadashi Asano, Onoda Cement Co., Ltd., Tokyo, Japan

The Internal Flow of Granulation During Compression of Tablets. Honorable Mention, General Photographs Ninth ASTM Photographic Exhibit. Allan M. Raff and Irving J. Romain, Smith, Kline and French Laboratories, Philadelphia, Pa.

E-11 Quality Control

A new Tentative Recommended Practice for the Probability Sampling of Materials (E 105) was completed by Committee E-11 this year. It covers principles for guidance of ASTM technical committees in the preparation of a sampling procedure for a specific material. A more complete summary of current activities in Committee E-11 appears on p. 34 this BULLETIN covering the recent meeting of the committee.

E-12 Appearance

The Symposium on Color of Transparent and Translucent Products was the principal contribution of Committee E-12 during the year. This symposium comprised 8 technical papers which have been published in the ASTM BULLETINS in October and December, 1954. Reprint copies of the symposium are also available from Society Headquarters. There are four E-12 subcommittees at work on the following subjects: (1) Definitions, (2) Color and Spectral Characteristics, (3) Gloss and Geometric Characteristics, and (4) Pictorial Representation.

E-13 Absorption Spectroscopy

Indexes to infrared ultraviolet spectra, in the form of IBM punched cards, have been made available for distribution by the Society. The infrared index now consists of 9091 cards covering the major catalogues of spectra and the spectra published in the current literature. The ultraviolet index consists of 1284 cards, all of which cover spectra published in current literature. The committee is coding spectra from other sources for addition to the ultraviolet index.

E-14 Mass Spectrometry

Forty-eight papers covering all phases of mass spectrometry were presented at the May, 1954, meeting of Committee E-14. The excellent coverage of the field by these papers represents an important contribution to the promotion of knowledge and advancement of the art of mass spectrometry.



Committee Established to Further Government-Industry Cooperation in Applied Research

THE National Academy of Sciences—National Research Council has been asked by officials of both industry and Government to establish within the Academy—Research Council framework a committee to concern itself with the common interests and relationships of industrial and governmental research, particularly in the area of applied research.

Conferences between industrial and governmental research executives and directors, called by the Academy—Research Council, recommended that a small committee be organized to explore the need for better acquaintance and understanding between Government and industry research leaders, and to consider methods for accomplishing this objective. As a result, the Government-Industry Research Committee has been organized by the Academy—Research Council with the following membership:

Edgar C. Bain, United States Steel Corp.,
Chairman
Allen V. Astin, National Bureau of Standards
D. P. Barnard, Deputy Assistant Secretary of Defense, Research and Development
Ralph Bown, Bell Telephone Laboratories, Inc.

Ralph Connor, Rohm & Haas Co.
Hugh L. Dryden, National Advisory Committee for Aeronautics
Paul D. Foote, Gulf Research and Development Co.
G. E. Hilbert, Agricultural Research Service, U. S. Department of Agriculture
Randolph Major, Merck & Co., Inc.
Roy C. Newton, Swift and Co.
Alan T. Waterman, National Science Foundation

At its first meeting the committee concluded that effective mechanisms already exist in many fields for furthering mutually helpful relations between Government and industry research. However, the committee agreed to hold itself available as necessary to assist in exchanging views and ideas designed to improve such relations where either Government or industry groups may feel this to be desirable.

When its services are requested, the committee proposes to consider first the extent to which the need can be satisfied by existing mechanisms. If appropriate, the committee will then consider designation of an *ad hoc* group of individuals active in the particular field concerned to assist in bringing about improved understanding and closer relationships between Government and industry people in that field.

Five Symposia Shaping Up for 1955 Annual Meeting

Additional Sessions Being Planned for Atlantic City Program

FIVE symposia are scheduled at this writing for the 1955 Annual Meeting of the Society which will be held in Atlantic City June 26 to July 3 at the Chalfonte-Haddon Hall Hotel.

In addition to the symposia, sessions are planned on Soils, Fatigue (with special reference to large-scale tests), Significance of Tests of Concrete, Pyrometric Practice in Elevated Temperature Testing.

Although final arrangements are still being worked out by the sponsoring ASTM technical committees, the following information on symposia is available at this time.

Speed of Testing of Non-Metallic Materials

Sponsoring Committee: E-1 on Methods of Testing

Effect of Speed of Testing on Tensile Strength and Elongation of Paper—*R. E. Green*

Effect of Speed of Testing on Mechanical Properties of Plastics (will also cover adhesives and building constructions)—*A. G. H. Dietz*

Effect of Speed of Testing on the Strength of Wood and Wood-Base Materials—*L. J. Markwardt*

Stress-Strain Relationships in Yarns Subjected to Rapid Impact Loading—*H. F. Schiefer, J. C. Smith, and F. L. McCrackin*

Effect of Speed in Mechanical Testing of Concrete—*J. J. Shideler and Douglas McHenry*

Effect of Speed of Testing on Tensile of Elastomers and Hard Rubber—*D. S. Villars*

Clays and Ceramics—*J. O. Everhart*
Glass—*H. N. Ritland*

Impact Testing

Sponsoring Committee: E-1 on Methods of Testing

Stress-Strain Relations Under Impact—*K. R. King, D. S. Wood, and D. S. Clark*
Transition Behavior in V-Notch Charpy Slow Bend and Impact—*Carl E. Hartbower*

How to Make the Charpy Impact Test Reproducible—*David E. Driscoll*

Impact Testing to -263 C—*T. S. DeSisto*

On the Dynamic Characteristics of Impact Machines—*J. J. Bluhm*

The Impact Tube: A New Experimental Technique for Applying Impulse Loads—*George Gerard*

Notched Bar Testing—Theory and Practice—*S. L. Hoyt*

Longitudinal Impact Tests of Long Bars with NBS Slingshot Machine—*W. Ramberg and L. K. Irwin*

Impact Deceleration Simulation on Rocket Powered Pendulum—*J. R. Townsend*

Railroad Shipping Container Shock Tester—*J. R. Townsend*

Compressive Tests of Concrete at High Rates of Straining—*David Watastein*
Strain Propagation in the Plastic Range—*D. A. Stuart and C. Ripartelli*

Atmospheric Corrosion

Sponsoring Committee: B-3 on Corrosion of Non-Ferrous Metals and Alloys

Effect of Natural Atmospheres on Copper Alloys—*A. W. Tracy*

Atmospheric Corrosion of Copper—Twenty-Year Test—*D. H. Thompson*

The Corrosion of Zinc in the Atmosphere—*E. A. Anderson*

Effect of Marine and Urban Atmospheres on Aluminum Alloys—*F. M. Reinhart and G. A. Ellinger*

Galvanic Couple Corrosion Studies by Means of the Threaded Spool and Wire Test—*K. G. Compton and A. Mendizza*

Atmospheric Corrosion Behavior of Some Nickel Alloys—*H. R. Copson*

Corrosion of Aluminum and Its Alloys—*C. J. Walton*

Corrosion of Lead and Tin and Their Alloys—*G. O. Hiers*

Disk and Washer Galvanic Corrosion of Light Metals—*H. O. Teeple*

Metallic Materials for Service at Temperatures Above 1600 F

Sponsoring Committee: Joint Committee on Effect of Temperature on the Properties of Metals

Effect of Rare Earth Additions on the High Temperature Properties of a Cobalt Base Alloy—*J. E. Breen and J. R. Lane*

Correlations of High Temperature Creep Data—*J. E. Dorn and O. D. Sherby*

Vacuum Sintered Molybdenum Base Alloys for Service at 1800 F—*D. D. Lauthers*

The Compression Creep Properties of Several Metallic and Cermet Materials at High Temperatures—*L. A. Yerkovich and G. J. Guarnieri*

Thermal Shock Testing of High Temperature Metallic Materials—*T. A. Hunter, A. R. Bobrowsky, and L. L. Thomas*

Stress-Rupture, Fatigue and Notch Sensitivity Properties of S-816 Alloy at Temperatures up to 1650 F—*P. H. Vitovec and B. J. Lazan*

Testing Techniques for Evaluating Materials for Service at Temperatures Above 1600 F—*S. S. Manson*

Metal and Non-Metal Types of Surface Protective Coatings for Use Above 1600 F—*J. W. Wolty and J. M. Riordan*

Review of Recent Developments in the High Temperature Ceramic, Cermet, and Intermetallic Field—*M. A. Schwartz*
Titanium Carbide Cermets Produced by the Infiltration Technique—*C. G. Goetzl*
High-Temperature Properties of Molybdenum-Rich Compositions Made by Powder-Metallurgy Methods—*W. L. Bruckart and R. I. Jaffee*

Use of Zirconium and Titanium Alloys for Surface Protection and Brazing of High Temperature Nickel and Iron Base Alloys—*A. Blainey*

Some Aspects of the Thermal Shock Resistance of Ceramic Materials—*P. Murray*

Chromium-Nickel Alloys for High-Temperature Application—*N. J. Grant, A. G. Bucklin, and E. Abrahamson*

Some High Temperature Sheet and Bucket Materials for Jet Engines—*F. Robert Shaw*

Interpretation of Soil Test Data

Sponsoring Committee: D-18 on Soils for Engineering Purposes

Four papers by qualified authors are scheduled for presentation in this symposium on (1) history of the work of Committee D-18, (2) a statement about the need for judgment factors, (3) a critical assessment of the committee by one of its leading critics, (4) a paper pointing the way to its future development of further work.

Kushnick Executive Director of ISA

WILLIAM H. KUSHNICK, new Executive Director of the Instrument Society of America, took over the top administrative post of the Society at its Pittsburgh headquarters early in December. In addition to this position, Mr. Kushnick will also act as publisher of the *ISA Journal*, the official monthly publication of the Society.

December Actions of Administrative Committee on Standards

IN ACTIONS taken on December 22, the ASTM Administrative Committee on Standards gave approval to recommendations for new tentatives, tentative, revisions of existing standards, and revisions of tentatives from seven of the Society's technical committees. A very brief résumé of the import of these additions and changes follows:

Lime-Gypsum

Approval was given to a joint recommendation from Committee C-7 on Lime and Committee C-11 on Gypsum covering Tentative Specification for Inorganic Aggregate for Use in Interior Plaster (C 35-54 T) wherein Section 3 (c) is changed to read: "For natural or manufactured sand the amount of material finer than a No. 200 sieve shall not exceed 5 per cent."

Glass and Glass Products

In proposing tentative revisions of Standard Definitions of Terms Relating to Glass and Glass Products (C 162) Committee C-14 brought these definitions into greater conformity with methods of measurement. Two new definitions are added: Strain Point and Annealing Range; and the definitions of Softening Point and Annealing Point are revised.

Thermal Insulating Materials

Four new tentatives have been prepared by Committee C-16: Specifications for Corkboard Thermal Insulation (C 352) cover detailed requirements of baked cork in board form intended to be used for thermal insulation purposes at any temperature below approximately 180 F.

Method of Test for Adhesion of Dried Thermal Insulating Cements (C 353) fulfills a long-felt need for a test method to determine this property. The method measures the relative adhesion of these cements to a particular test surface. While valuable in rating these products generally the committee points out that adhesion of the cement to one type of surface cannot be construed as being fully indicative of the adhesion to another type of surface.

Tentative Methods of Test for Water Vapor Transmission of Materials Used in Building Construction (C 355) applies to materials greater than $\frac{1}{8}$ in. and not over $1\frac{1}{2}$ in. in thickness, materials which were not previously provided for in the Tentative Methods of Test for Measuring Water Vapor Transmission of Materials in Sheet Form (E 96).

The Scope of the new Methods reads in part:

They describe procedures for determining the water vapor transmission of materials used in building construction, through which the passage of water vapor may be of importance, such as fiberboards, gypsum and plaster products, wood, and plywood. Two methods, the 'Desiccant Method' and the 'Water Method' are provided for the measurement of permeance under two different test conditions. Duplication should not be expected between results obtained by the two methods. Results by the 'Water Method' are frequently much higher. That method should be selected which more nearly approaches the conditions of use.

Paint, Varnish, Lacquer, and Related Products

Committee D-1 has improved and revised the method of test for Nonvolatile Matter, Section 6 of Standard Methods of Sampling and Testing Lacquer Solvents and Diluents (D 268-49) and set it up as Tentative Method of Test for Nonvolatile Matter of Lacquer Solvents and Diluents (D 1353).

Electrical Insulating Materials

Eight recommendations for revisions to standards and tentatives came from Committee D-9 as follows.

Tentative Method of Testing Vulcanized Fiber Used for Electrical Insulation (D 619) is revised to make the lower limit of thickness of test pieces $\frac{1}{32}$ in. since additional testing has shown that good results are obtained at this thickness.

In Tentative Method of Testing Nonrigid Polyvinyl Tubing (D 876) several changes have been made to improve the accuracy and consistency of the Method.

Tentative Specifications for Nonrigid Polyvinyl Tubing (D 922) were revised to provide more general coverage and also to include additions pertaining specifically to the grades of tubing.

Materials made recently available have necessitated a change in tensile strength and air resistance requirements in Tentative Specifications for Absorbent Laminating Paper for Electrical Insulation (D 1080).

Latest Actions Taken by Administrative Committee on Standards, December 22, 1954

New Tentatives

Specifications for:
Corkboard Thermal Insulation (C 352 - 54 T)

Methods of Test for:
Adhesion of Dried Thermal Insulating Cements (C 353 - 54 T)
Compressive Strength of Thermal Insulating Cement (C 354 - 54 T)
Water Vapor Transmission of Materials Used in Building Construction (C 355 - 54 T)
Nonvolatile Matter of Lacquer Solvents and Diluents (D 1353 - 54 T)

Tentative Revisions of Standards

Methods of:
Testing Laminated Tubes Used for Electrical Insulation (D 348 - 52)
Testing Laminated Round Rods Used for Electrical Insulation (D 349 - 52)
Sampling Electrical Insulating Oil (D 923 - 49)

Definitions of:

Terms Relating to Glass and Glass Products (C 162 - 52)

Revisions of Tentatives

Specifications for:
Nonrigid Polyvinyl Tubing (D 922 - 52 T)
Absorbent Laminating Paper for Electrical Insulation (D 1080 - 52 T)
Low-Alloy Steel Arc-Welding Electrodes (A 316 - 48 T)
Inorganic Aggregate for Use in Interior Plaster (C 35 - 48 T)

Methods of:

Testing Vulcanized Fiber Used for Electrical Insulation (D 619 - 52 T)
Testing Nonrigid Polyvinyl Tubing (D 876 - 52 T)
Test for Silicone Insulating Varnishes (D 1346 - 54 T)
Chemical Analysis of Aluminum and Aluminum-Base Alloys (E 34 - 50 T)

Revision of Tentative Methods of Test for Silicone Insulating Varnishes (D 1346) consists of adding a procedure for determining heat stability or effect of elevated temperatures on silicone varnishes.

Tentative Revisions of Standard Methods of Testing Laminated Tubes Used for Electrical Insulation (D 348) and Standard Methods of Testing Laminated Round Rods Used for Electrical Insulation (D 349) were recommended to bring them into line with Tentative Methods of Test for Compressive Properties of Rigid Plastics (D 695) and Tentative Specifications for Laminated Thermosetting Materials (D 709) and also to include in both methods new significance statements.

Additions have been made to Standard Method of Sampling Electrical Insulating Oil (D 923) which make the sampling more practicable and more consistent with present practices in industry. Cautions have also been added.

Chemical Analysis of Metals

Committee E-3 recommended addition to Tentative Photometric Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys (E 34) of a more rapid method of determining silicon in aluminum alloys.

Filler Metal

The Joint American Welding Society-ASTM Committee has developed chemical requirements to be added to Tentative Specifications for Low-Alloy Steel Arc-Welding Electrodes (A 316). It was understood in 1948 when the Specifications were first proposed that they would be subsequently expanded to include these additions.

The title has been changed to "Specifications for High Tensile and Low Alloy Steel Arc-Welding Electrodes." A longitudinal bend test has been added which allows the use of mild steel for test plates rather than a wide variety of low-alloy steels which would be required if transverse bending were to be specified.

A press which briquettes powdered metal at Moraine Products Division of General Motors is a 4,000,000-pound hydraulic press. It could lift a World War II destroyer of about 2,100 tons.

Sampling of Ores—Is Standardization Needed?

One of the fields in which standardization activity appears to be lacking is that of bulk sampling of ores for chemical analysis and size classification. The number of inquiries received at ASTM Headquarters requesting information along these lines have been numerous since 1951. There have been inquiries on all ores but most have covered iron, manganese, chromium, nickel, tungsten, and vanadium. Practically all have been concerned with methods for bulk sampling or size classification.

Since it appeared as though no commercial standards on this subject were available in the United States, letters were written in August, 1954, to The South African Bureau of Standards, Indian Standards Institution, Standards Association of Australia, and the British Standards Institution. To date the only comparable standards received were two from the Indian Standards Assn. on manganese ore. Federal Specification QQ-M-71 issued in 1932 also covers one grade of manganese ore and includes requirements on form,

manganese content, methods of test, and inspection.

Lately the Society has been advised that development of methods of chemical analysis, within certain limits, would be a feasible and needed activity; also that testing methods for synthetic open-hearth "feed" or "charge" ore as a basis for specifications are desirable. There is considerable activity toward the production of briquetted or blocked iron ore for use in open-hearth operations, but the work is hampered by the lack of specifications and methods of test.

The Board of Directors and the Society Headquarters Staff need more information from people directly concerned with sampling and testing of ores before a decision on standardization work can be reached. It is hoped that this article will reach some directly, and others indirectly through the reader's knowledge of such individuals. All comments on any aspect of this field of activity will be greatly appreciated by Society Headquarters.

International Meeting on Plastics Standardization Held in England

THE International Standards Organization Technical Committee on Plastics (ISO/TC 61) made up of representatives of ten nations met at Brighton, England, during October 4-8, 1954. The leader of the U. S. delegation was Robert Burns, Bell Telephone Laboratories, and other U. S. members included C. Ainsworth, American Standards Assn.; C. Condit, Society of the Plastics Industry; L. Gilman, Picatinny Arsenal; G. M. Kline, National Bureau of Standards; R. R. Winans, Brooklyn Navy Yard; R. K. Witt, Johns Hopkins University; E. Y. Wolford, Koppers Co.; and W. A. Zinzow, Bakelite Co. Presiding as chairman was G. M. Kline (USA) and as co-chairman, H. V. Potter (UK). Technical secretaries for the meeting were C. Condit (USA) and H. T. Lawrence (UK).

That progress is being made toward international accord in this area was indicated by the fact that five test methods were approved as Draft ISO Recommendations at the Plenary Session on October 8. Subjects involved were water absorption, apparent densities of molding powders, acetone

soluble matter in phenolic plastics, and the relation of temperature to deflection under load. Also, eight other items were approved as Draft ISO Proposals. These were related to standards for equivalent terminology in English and French, flexural properties of rigid plastics, standard conditioning of plastics prior to testing, standard laboratory atmospheres for testing plastics, determination of free phenols and ammonia in phenolic moldings, determination of methanol soluble matter in polystyrene, and boiling water absorption characteristics of plastics.

ISO/TC 61 is composed of six working groups, each of which met separately at least three times during the week. The groups are concerned with nomenclature, mechanical properties, thermal properties, physical-chemical properties, chemical and environmental resistance, and testing and conditioning atmospheres.

Present plans are to have the 1955 meeting in Paris, probably in July.

NOTE—A more complete report of International Plastics Meetings during 1954 may be found in *Modern Plastics*, Vol. 32, No. 4, p. 92.

Marburg Lecture—Interpretation of Scientific and Engineering Data

THE 28th Edgar Marburg Lecture entitled, "Interpretation of Scientific and Engineering Data," was presented by Harold F. Dodge, Quality Results Engineer, and member of the technical staff of Bell Telephone Laboratories, Inc., New York, N. Y.

The author clearly demonstrates the use of certain statistical methods, such as frequency distribution, estimates and confidence limits, control chart techniques, and acceptance sampling plans in the interpretation of engineering data. The lecture is indeed an outstanding contribution to the field of quality engineering, in pointing out how statistical methods and quality control techniques can provide a means for approaching the goal of statistical quality control in any segment of endeavor where valid prediction can be made regarding the output of future operations.

Using audience participation and visual aids, Mr. Dodge conducted a sampling experiment to illustrate how and why a knowledge of the nature of chance variations may be of assistance in planning inspection and testing work, and equally as useful in interpreting data obtained in the laboratory or in the manufacturing plant. If the causes of variation in the quality of a product continue to have the same probability of contributing a given effect, then the quality of the product is considered to be in a "state of statistical control." The cumulative effect of all the causes can be represented by a frequency distribution which in turn can be regarded as a statistical representation of the production process.

It can be argued that this concept of a state of statistical control is unattainable in that it is practically impossible to maintain such a high degree of constancy in the entire stream of product turned out by any industrial process; however this concept is held mainly as the ideal upon which a mathematical model is based. The model is constructed by using the notions of frequency distribution, and unchanging distribution—symbolizing a constant system of chance and cause—to set up certain criteria for decisions. Therefore a set of observations taken in the factory or laboratory, under essentially the same conditions, can be assumed as

indicative of the underlying distribution of possible observations at the time and for the condition under which the data were obtained.

The quality engineer is forever faced with the problem of being forced to judge the quality of the entire product lot, or "universe," from the results of testing only a few. Depending upon certain factors, a sample may be regarded either as a sample from a limited universe—to provide information or a basis for action regarding the finite quantity at hand; or as a sample from an unlimited universe—to provide information or a basis for action regarding the production process or system of causes. This distinction has a direct bearing on the problems of collection and interpretation of most engineering data.

The basic purpose of operation of statistical control is to obtain a constant system of chance causes, one such that quality will be consistently uniform in order to predict future quality from past uniformities. Thus the operation of statistical control is primarily a procedure of searching and eliminating assignable causes.

This Lecture will be published in full in the 1954 *Proceedings* and may be obtained now in pamphlet form from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: \$1.50; to members, \$1.15.

Infrared and Ultraviolet Spectral Absorption Index Cards

THE American Society for Testing Materials, by arrangement with Wyandotte Chemicals Corp., is now handling the distribution of the punched IBM card system developed by L. E. Kuentzel of Wyandotte Chemicals Corp., for indexing spectral absorption data.

Cards indexing both infrared and ultraviolet spectra are now available. The Infrared spectra index totaling 9091 cards (with Book of Codes and Instructions) is priced at \$90 and indexes spectra from the following sources: American Petroleum Inst. Project 44, Sadtler Catalog of Spectrograms, special

group of spectra of detergents from Sadtler Catalog, NRC-NBS File of Spectrograms (Creitz), and Spectrograms abstracted by ASTM-sponsored groups. The index of ultraviolet spectra, totaling 1284 cards (with Book of Codes and Instructions) is priced at \$17 and covers two groups: spectra found in the book, "Ultraviolet Spectra of Aromatic Compounds," by R. A. Friedel and Milton Orchin (John Wiley and Sons, Inc., 1951) and spectra abstracted from the literature by ASTM-sponsored groups.

The index cards pertaining to ultraviolet spectra are distributed separately for the convenience of the many laboratories that are not interested in both infrared and ultraviolet work.

For those who purchased the first index covering 7705 infrared spectra which became available for distribution in January 1954, there is now available a supplement containing 1580 cards which brings the total number of infrared index cards up to 9091 and replaces a number of cards in the first deck. All buyers of record have been notified directly by letter. The supplement deck is available at \$19.50.

ASTM Committee E-13 on Absorption Spectroscopy has assumed the responsibilities connected with the development and maintenance of the above system, which is being used by an increasing number of laboratories. This will provide for the perpetuation and orderly modification of the system in the interests of a greater number of people, provide a mechanism for supplying the cards and codes through a single agency at as reasonable a price as possible, and will furnish the manpower to insure greater coverage and accuracy of the data issued. In assuming responsibility for the system, the committee has made thorough tests of all indexing codes. Certain changes have been made in the codes applying to the classification of chemical structure, and an enlarged and revised booklet of codes and instructions has been prepared. It is anticipated that no further substantial changes in the coding system will be made for the next several years.

The revisions made by committee action, which entailed bringing the master cards into conformity with the new code, render obsolete all old IBM cards punched by Wyandotte prior to 1954. It is hoped that the greater stability and permanence of the system,

the improvements in coding and sorting, and the greater guarantee of accuracy and wide coverage which control by ASTM provides will more than offset the relatively small financial sacrifice that will accompany the discarding of the older cards.

Full information concerning the infrared and ultraviolet index cards, is available from Society Headquarters, 1916 Race St., Philadelphia 3, Pa.

Standards on Mineral Aggregates, Concrete, and Nonbituminous Highway Materials

For the convenience of those concerned with highway construction materials the various ASTM specifications, test methods, and definitions of terms pertaining to mineral aggregates, concrete, and nonbituminous highway materials, are compiled in one publication sponsored by ASTM Committee C-9 on Concrete and Concrete Aggregates and Committee D-4 on Road and Paving Materials. It also includes a few pertinent specifications for cement under the jurisdiction of Committee C-1 on Cement.

This book will be useful to producers and consumers as well as to specification writers, testing and inspection personnel, and to research and engineering institutions. The nearly 100 tests, methods, specifications, and definitions of terms in their latest approved form cover aggregates, concrete, brick and block pavement materials, concrete curing materials and expansion joint fillers, and cement.

This 350 page compilation can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: \$3.50; to members, \$2.65.

Standards on Rubber and Rubber-Like Materials

IN THIS compilation are found all the standard methods of test and specifications developed through the work of ASTM Committee D-11 on Rubber and Rubber-Like Materials. This committee, organized in 1912, has carried out a great amount of research and development work and has gathered voluminous data all of which have tied in directly with its important work of making available authoritative methods of testing.

This volume included 133 standards and specifications under the following general classifications: processibility

tests; chemical and physical tests of vulcanized rubber; aging, weathering, and low-temperature tests; automotive and aeronautical rubber; packing and gasket materials; hose and belting; tape; electric protective equipment; rubber coated fabrics; insulated wire and cable; hard rubber; latex foam; sponge and expanded cellular rubber; rubber adhesives; crude rubber; rubber latex; nonrigid plastics; electrical tests; nomenclature and definitions; and general test methods.

In addition, the compilation also includes an appendix covering Proposed Methods of Testing Rubber Thread, and the Regulations Governing Committee D-11.

Bound in heavy paper cover, and totaling 684 pages, this compilation can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: \$5.50; to members, \$4.25.

Errata

In the Tentative Method of Test for Determination of Purity from Freezing Points (D 1016 - 54 T) there is an omission in the freezing point for zero impurity of methyleyclohexane. In Section 14, of Method D 1016, the freezing point for methyleyclohexane now appears as follows:

$$t_0 = -126.593 \text{ C.}$$

It was intended to read as follows:

$$t_0 = -126.589 \pm 0.015 \text{ C.}$$

This omission appears in Method D 1016 as published in the 1954 Supplement to Book of ASTM Standards, Part 5, p. 77, and also in the compilation of "ASTM Standards on Petroleum Products and Lubricants," November, 1954, p. 478. Members having these publications will wish to note this correction on their copies of Method D 1016 in these two publications.

In "Report on the Elevated Temperature Properties of Chromium-Molybdenum Steel," *STP No. 151*, the figure headed "Rupture in 100 Hours" on page 30 should be "Rupture in 1000 Hours." On page 31 the figure "Rupture in 1000 Hours" should be "Rupture in 10,000 Hours."

In the personnel of our Administrative Committee on Papers and Publications appearing on page 1 of the 1954 Year Book, Mr. L. C. Burroughs is still listed as a member. Mr. Burroughs was succeeded by Mr. S. S. Kurtz, Jr., who is a member of the committee for the term expiring in 1956.

1955 Book of Standards—Bigger than Ever

THE 1955 Book of Standards is now looming on the ASTM publications schedule horizon. Careful estimates by the Staff based upon the records of new standards published in the past two years and to be published in 1955 indicate that the 1955 Book will be about 16 per cent larger than the 1952 edition. The entire Book will contain over 2100 Standards and Tentatives totaling more than 11,500 pages. With each Part larger and containing more Standards than ever, members will get even more value for their membership dues dollar.

Once again the Book of Standards will be published in seven Parts. Members receive on their membership any one Part and its Supplements without extra charge. Many have elected to receive on a continuing basis two, three, or more Parts and Supplements at an annual charge of \$3 per part. About 40 per cent of our members get all seven parts. The members' instructions in this regard are kept on file at ASTM Headquarters and shipments of the Book of Standards and its Supplements are made automatically against these instructions. Members also have the privilege of buying extra Parts at prices considerably under the list price.

The reference value of the Book of Standards cannot be overemphasized. Although in many circumstances one or two Parts of the Book of Standards pertaining to the specialty of the engineer or corporation may be adequate for 90 per cent of the problems which arise, having a complete book on hand for the other 10 per cent would be of great value and justify the relatively few more dollars spent annually to obtain a complete set.

The 1952 edition for the first time was printed on bible paper to conserve weight and shelf space. The 1955 edition will be printed on bible paper of greater firmness and opacity to produce an even better book than the previous edition where the printing showed through the page slightly—a not too objectionable but somewhat undesirable result of our first experience with bible paper.

The 1955 edition will be ready earlier than previous editions—the last part scheduled to be available before the end of February, 1956. Printing will begin in September of 1955, as soon as possible after the return of ballots ratifying standards adopted at the 1955 Annual Meeting. The printer has estimated that it will take three presses working 16 hours a day a total

of four months to print the book—the equivalent of one high-speed press working two shifts per day for one year.

The Society will invest about \$235,000 in the actual printing and distribution—and this is but a small portion of the total dollar value of the time and effort and research and knowledge and experience which go into the development of the standards comprising the book.

But, as with any investment—machines, tools, buildings, industrial plants—the Book of Standards only becomes valuable as it is used. Its wide distribution and use throughout the world and especially in the United States and Canada is a source of gratification to the Committee men who have given so generously of their time and thought and effort in producing the standards.

The Book of Standards can only be as valuable and useful as it is because of the confidence placed in its reliability. Again credit is due the committees for their constant vigilance in keeping abreast of the needs in all fields of materials for new standards and for revisions of existing standards to see that they keep abreast of progress and that new ones are added to fill the gaps which may become evident as new techniques and materials come into being.

The 1955 Book of Standards will include all of the ASTM specifications, tests, definitions, recommended practices, etc., in their latest approved form. Notices of availability and order blanks will be sent to all members, committee members, and purchasers of the book in past years about one month before the first Part is available, probably about October of 1955.

1955 BOOK OF STANDARDS PRICES

	Members For Extra Copies*		Nonmembers
Part 1 Ferrous Metals	\$10.00		\$13.50
Part 2 Non-Ferrous Metals	8.50		11.00
Part 3 Cement, Concrete, Ceramics, Thermal Insulation, Road Materials, Waterproofing, Soils	10.00		13.50
Part 4 Paint, Naval Stores, Wood, Sandwich Constructions, Fire Tests, Wax Polishes	8.50		11.00
Part 5 Fuels, Petroleum, Aromatic Hydrocarbons, Engine Antifreezes	8.50		11.00
Part 6 Rubber, Plastics, Electrical Insulation	9.00		13.00
Part 7 Textiles, Soap, Water, Paper, Adhesives, Shipping Containers	8.50		11.00
Complete Set	63.00		84.00

* Each number gets one selected Part on his membership and can procure the other Parts and Supplements at annual charge of \$3 per Part.

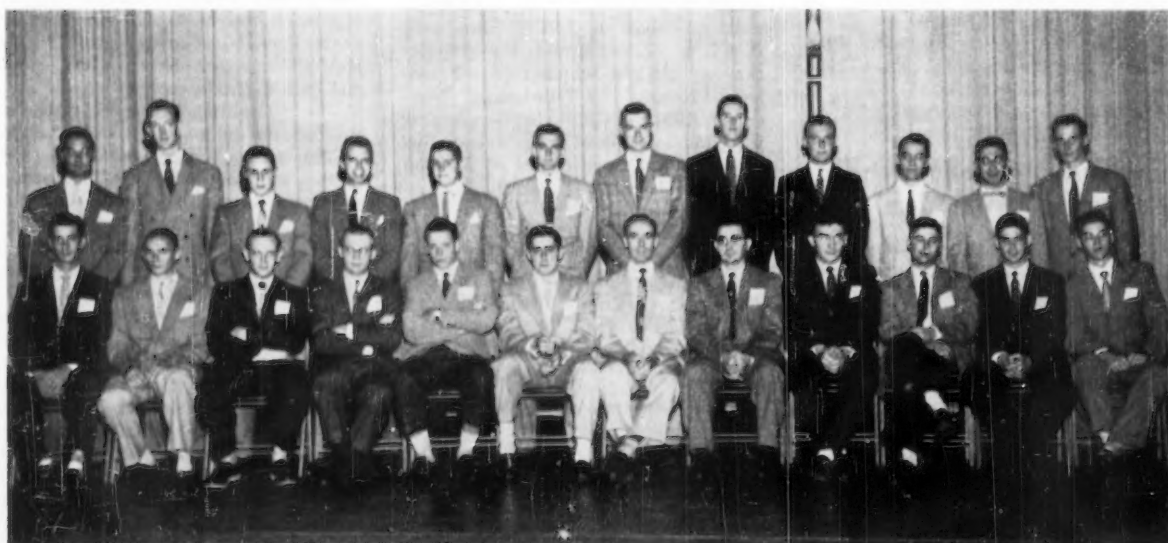
1955 Nominating Committee Appointed

IN ACCORDANCE with the By-laws providing that the Board of Directors shall select a nominating committee for officers, the Board has considered the report of the tellers—J. J. Moran and S. S. Kurtz, Jr.—on the recommendation of members for appointees on the nominating committee and alternates, and has appointed those shown in the table.

Serving on the 1955 Nominating

Committee as *ex officio* members are the three immediate past-presidents: T. S. Fuller, H. L. Maxwell, and L. C. Beard, Jr. The committee will meet in March and will nominate for each office—president, vice-president, and five members of the Board of Directors. The selection by the Nominating Committee will be announced to the members in the ASTM BULLETIN prior to transmission of the official ballots.

Members	Respective Alternates
J. G. Morrow, Steel Co. of Canada	J. K. Killmer, Bethlehem Steel Co., Inc.
W. C. Hanna, Calif. Portland Cement Co.	A. A. Bates, Portland Cement Assn.
G. H. Harnden, General Electric Co.	I. V. Williams, Bell Telephone Labs., Inc.
A. E. Miller, Sinclair Refining Co.	C. A. Neusbaum, Standard Oil Development Co.
W. T. Pearce, Consultant on Organic Coatings	J. C. Moore, Nat'l Paint, Varnish and Lacquer Assn.
H. H. Morgan, R. W. Hunt Co.	A. R. Ellis, Pittsburgh Testing Lab.



Student Membership Prizewinners at the Recent Philadelphia District Meeting.

Development and Growth in ASTM

By H. H. Lester

These notes were used by Mr. Lester, consulting engineer and past-chairman of the New England District, at the Annual District Officers Meeting in June, 1954.

THE question of development and growth is of great importance to the ASTM. It is obvious that this development and growth must be dependent primarily upon the value of the service the Society performs for our industrial economy and, specifically, for the engineering professions which it directly serves. The value to the individual member must derive from this.

It has been thought in the ASTM New England District that a better understanding of the aims and purposes of the Society would tend toward building respect, appreciation, and good will and would be an incentive for membership. It has seemed that the best point of attack in a campaign to increase appreciation and good will is at the college level—in faculties of engineering schools and among the students themselves. It has also seemed that the best sort of attack would be the enlistment of engineering faculties and students in aspects of the Society's work. Through such *direct* contact, they can best understand and appreciate the things for which the Society stands.

We have chosen in New England to select for our campaign for better understanding that aspect of ASTM work that seems to us to be broadest and most appealing, that is, the general subject of materials and their importance to engineers. We believe that a better appreciation of materials for engineering will lead automatically to a better appreciation of the ASTM. In the

performance of this undertaking, it has been found advisable to attempt a broad formulation of the aims of the Society. The following generalization, while having no official sanction, is consistent with the ASTM Charter which indicates the Society to be among other things, a "Corporation for the Promotion of Knowledge of the Materials of Engineering":

The American Society for Testing Materials sponsors the cause of materials for engineering application. It is interested in engineering materials; the testing of them; the specifications that concern the descriptions of their desired quality characteristics; and last, but not least, the basic and developmental researches that are necessary to improve materials and to produce new ones that may have intriguing engineering possibilities.

The New England program has chosen to emphasize the last of the above aims, namely, that associated with research and development.

The project for better understanding at student levels has been the responsibility of our "educational" committee, headed first by Past-President H. J. Ball, and now by Prof. W. D. Clement of the University of New Hampshire. Daniel Cushing, Metallurgical Consultant, served as acting chairman during most of the past year. In the spring of 1954, a meeting at the University of Connecticut was arranged by this committee working with an able program committee headed by R. W.

Woodward of the Underwood Corp.

An essential to the success of a meeting of this sort is the complete cooperation of the university faculty. In fact, without such support, the likelihood of success is not great. In the case of the University of Connecticut meeting, this support was forthcoming. Professor Castleman, Dean of Engineering, recognized the value of the cause we represented and was particularly helpful with the preliminary work as well as with the meeting itself. Other faculty members also contributed, especially E. L. Bartholomew, Professor of Metallurgy, who carried much of the burden of local arrangements. Such support could not have been obtained unless the faculty men themselves were sold on the idea of the importance of materials, and unless they regarded the idea of the meeting as completely worthy.

It is regarded that a year's planning is needed to insure success in a meeting of the sort we have in mind. Preparations for a similar meeting at the University of New Hampshire in the spring of 1955 are already well advanced.

Chemical Progress Week May 16-21

THE second Chemical Progress Week has been scheduled for May 16-21, 1955, it has been announced by the Manufacturing Chemists' Assn., sponsor of the event.

The board of directors of the MCA, made up of top-level industry executives will serve as the sponsoring committee. The program will be national in scope with emphasis on local-level activities, particularly in chemical industry plant-communities, the announcement said.

25-YEAR MEMBERS

1930-1955

Albert, Edward J.
American Bitumuls and Asphalt Co.
American Can Co.
American Hardware Corp., The
Arizona, University of, Library
Armed Steel Corp., Rustless Division
Baker, Herbert J.
Bartram, Robert W.
Bauer, Edward E.
Blundon, J. Paul
Boyd, T. A.
Brewster, Geo. M. and Son, Inc. (1928)
Canadian Pacific Railway Co.
Carney Co., Inc.
Chandler, Henry
Compania Peruana de Cemento Portland (Peruvian Portland Cement Co.)
Crane, Clyde C.
Davidson Brick Co.

Denham, George B.
Detroit, University of
Dodge, Ralph L.
Dow Chemical Co., The (1918)
Dresser Manufacturing Division
Dresser Industries, Inc.
Eakins, E. E. (1921)
Ekholm, L. E.
Emanuelli, Luigi
Emerson, H. B.
Ferguson, D. Hamilton
Friedgen, Arthur E.
Georgia Institute of Technology Library (1919)
Gothard, N. J.
Greene Brothers, Inc.
Gurley, W. & L. E.
Gypsum Assn.
Hanlon-Gregory Galvanizing Co.
Hardesty, James M.
Hartford Steam Boiler Inspection and Insurance Co., The
Heilig, William

Hill, H. O.
Hoffman, Edgar R.
Hulme, Cedric E.
Kelsey-Hayes Wheel Co.
Kent, N. Johnson
Kenyon, Reid L.
Kuhls, H. B. Fred
Larson, Clifford M.
Lepage, L. J. C.
Linde Air Products Co., Division of Union Carbide and Carbon Corp.
Litebiser, H. R.
Los Angeles, City of, Harbor Dept.
Luton, R. E.
MacKay, Kenneth M.
Mackie, I. C.
Malcolmson, James D.
Mexican Light & Power Co., Ltd. (1924)
Michigan, University of, Transportation Engineering Division
Mitchell, Clinton K.
Morris, Lloyd M.
Mueller Brass Co.
Nardiello, Manuel V.
Nova Scotia Department of High-

ways
Ott, John Ekern
Pan-Am Southern Corp.
Pennsylvania Water and Power Co.
Porter, George H., III
Rader, Lloyd F.
Reid, Lewis S.
Richmond, City of, Department of Public Works
Rutgers University, Bureau of Engineering Research
St. Louis Public Library
Schurtz, D. D.
Shepard-Pendleton, Ltd.
Standard Oil Co. (Ohio), The
Tennessee State Highway Dept.
Texas State Highway Dept.
Thomas, Howard R.
Tracy, Arthur W.
Uhle, D. J.
Upham, E. W.
West Penn Power Co.
Wilk, Benjamin
Wilkins, Richard A.
Williams, C. G.



JANUARY 1955

NO. 203

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Our ASTM Publications—Some Thoughts

ONE can evaluate the ASTM publications from different viewpoints, but no matter how they are analyzed or studied they seem to be serving valuable purposes.

Looked at from the mundane (but important) financial point of view, our books, both the standards and the special technical publications, represent a most important part of our financial support. For example, in 1953, total receipts were about \$815,000, and just over \$512,000 came from sales of our various publications. Dues were less than half of this figure, indicating that publications are vital in helping to underwrite new work and assist in keeping the Society alert to meet its mandate from industry and Government. Of course a society in a healthy financial state can concentrate its efforts on production and expansion with the reasonable assurance that new activities, and new publications can be brought forth without the harrowing worry of adequate financing.

Although intensive efforts are put forth by the Developmental Committee to acquaint technical men with our publications, here as in all fields of endeavor a poor product would not long be in demand. We should like to comment about the quality and nature of our books, particularly the special technical publications—STP's.

Cooperative Effort

It should be noted *first* that every ASTM book is the result of cooperative effort. Obviously some individual or group must spark the effort, but the value of an STP rests in considerable measure on the fact that it usually presents the composite opinion of leaders in the field. We were recently discussing the practice of different societies in processing papers and publications and found that in some groups an editor or a staff official has virtual sole

authority to decide on the merit of a contribution and whether or not it is accepted. Down through the years the ASTM policy has been that papers contributed by authors shall be reviewed by at least two other technical authorities. This practice is rigorously adhered to, and we should like here to pay tribute to the large number of ASTM members and committee members who review and evaluate critically the papers referred to them.

Before the printer gets the material, the manuscripts are gone over critically by Staff editors, and the author is asked finally to approve an edited and revised manuscript. After it is set in the type he receives a set of galley proofs for a critical reading.

Where a symposium or collection of papers is involved there is always a committee in charge. This technical group of industry and Government leaders, selected because of the individual skills and capacities represented, is charged by the technical committee sponsoring the book, or by the Administrative Committee on Papers and Publications, with seeing that the final result is of maximum value.

Sometimes intensive efforts are required. We have in mind the new symposium sponsored by the Joint Committee on Effect of Temperature covering "Effect of Temperature on the Brittle Behavior of Metals with Particular Reference to Low Temperatures"—STP 153. As originally submitted this publication would have run to perhaps 800 pages. Partly to overcome duplication, and to increase its timeliness, and current value, the ultimate publication as issued was "boiled down" to 480 pages. Here close collaboration among the editors, the Joint Committee, the symposium committee, and the authors resulted in a really valuable book.

The STP's provide the latest informa-

tion on the subject being covered. Presented as they are concisely and in a readable format, thousands of engineers and others constantly find them of real value as indicated by our increasing sales and the continuing demand for these books.

But there are other purposes served by many of the STP's. For example, the Reports on Significance of Tests, which apply to various materials—concrete and concrete aggregates, petroleum products, and coal and coke, etc., help the committees provide the users of the standard methods with a critical evaluation of just what the test is intended to do. This type of information can hardly be covered in the printed test unless it were greatly enlarged.

A committee, particularly in the early stages of its work, may sponsor a symposium either to provide a firm basis for the understanding of the work expected or to acquaint other ASTM technical committees and technologists with a better knowledge of the subject. An example of this is the recent Symposium on Radioactivity which is labeled as "an introduction." This STP 159 is intended to provide pertinent information for those who are in a position to use this relatively new tool. This STP exemplifies another occurrence—not too frequent to be sure, but nevertheless, significant. It had not been planned that this symposium would be issued in printed form, but because of the good work of the authors and the committee, there was a demand that it be published.

Committee D-2 on Petroleum Products and Lubricants which has sponsored so many valuable books decided through its Technical Committee F that the new Symposium on Diesel Fuels (STP 167) could provide a better understanding in connection with the production, selection, and use of these materials.

Much more could be written about our STP's—and about some of our special compilations of standards (refractories, and textiles, for example) which in themselves embody reports and data that are neither specifications or tests, but are included to make the book more useful.

We sometimes wonder whether the hard work of the sponsoring committees, the authors, and the Headquarters editors is fully recognized and appreciated, but we know that those who are concerned with the subject find the books continually of real interest and help.

This writer, not directly involved with Headquarters editing or mechanics, can nevertheless vouch for the extreme care and intensive effort our editors devote to our books. Our aim of high-

caliber editing is naturally fitting if for no other reason than to indicate appreciation for the work of the authors and members who make the STP's possible.

There is no particular reason why the above thoughts could not have been and continue to be recorded almost any time. We happened to be reviewing three or four recent STP's and also the October BULLETIN which gave interesting abstracts of some of the new books, and as always were impressed with this phase of our operations.

While the Board of Directors has assigned specific responsibility to the Administrative Committee on Papers and Publications for over-all guidance of our very extensive publication efforts, they are ever acutely conscious of our publications, review and discuss various items in the Board meetings, and, too, are appreciative of the good, intensive work embodied.

R. J. P.

61 Transfers to Sustaining Membership

CHAIRMAN A. O. Schaefer of the Membership Committee, and all Directors of the Society are gratified to announce the transfer to sustaining membership by the following companies:

Air Reduction Co., Inc.
 Alan Wood Steel Co.
 Allegheny Ludlum Steel Corp.
 Allentown Portland Cement Co.
 Allis-Chalmers Manufacturing Co. (Milwaukee, Wis.)
 American Can Co.
 American Felt Co.
 American Oil Co. (Texas City, Tex.)
 Anaconda Wire and Cable Co.
 Ashland Oil & Refining Co.
 Baldwin-Hill Co.
 Boston Edison Co.
 The Budd Co. (Philadelphia, Pa.)
 Byerlyte Corp.
 Calumet & Hecla, Inc. (Calumet Div.)
 Canadian National Railways
 Champion Spark Plug Co.
 Clevite Corp. Research Center
 Collins Radio Co.
 Continental Can Co., Inc. (Chicago, Ill.)
 Corning Glass Works
 Dayton Malleable Iron Co.
 Dragon Cement Co., Inc.
 Eastern Stainless Steel Corp.
 Federal Portland Cement Co., Inc.
 Ferro Corp.
 Fisher Scientific Co.
 Fruehauf Trailer Co.
 The General American Transportation Corp.
 Gladding, McBean and Co.
 Grinnell Co., Inc.
 The Harshaw Chemical Co.
 Hercules Cement Corp.
 Hughes Aircraft Co.
 Imperial Oil, Ltd. (Canada)
 International Resistance Co.
 Joslyn Manufacturing and Supply Co.
 Kaiser Steel Corp.
 A. & M. Karageusian, Inc.

Membership 7762 Members' Continued Aid Enlisted

With a net gain in 1954 of 181 new members, the Society's membership, as of December 31, 1954 totaled 7762, classified as follows:

Honorary	21
Perpetuity and Life	11
Sustaining	275*
Company (including Trade Associations)	1827
Individuals (including Institutions, Scientific Associations, and Government Departments)	5539
Junior (under 27 years)	89

In addition, approximately 500 students in engineering schools throughout the country were enrolled as ASTM student members. Although the new member-enrolled totaled 602, as usual there were rather heavy losses from deaths, resignations, and other causes.

Much of the credit for the steady, continuing growth of the Society should go to the current members who in large measure are responsible for maintaining the organization on an even keel through their interest, support, and recommendation of prospective members.

The income from membership dues necessarily plays an important part in the maintenance of the Society's expanding technical activities, and of especial significance is the support of our sustaining members. Although not appearing in the year-end classification, there has been a very substantial increase in the number of sustaining members through transfer to this class as of January 1, 1955. (See accompanying article.)

The Directors serving on the Membership Committee, and in fact all officers of the Society, are sincerely appreciative of the interest and activity of all ASTM members, and anticipate continuing support in 1955—hopeful that this new year will show greater increases in all classes of affiliation.

* Increased to 336 at beginning of year.

Kelsey-Hayes Wheel Co.
 Keystone Portland Cement Co.
 Linde Air Products Co., Div. of Union Carbon and Carbide Corp.
 Arthur D. Little, Inc.
 The Lubrizol Corp.
 Mexican Light and Power Co., Ltd.
 Mundet Cork Corp.
 Nazareth Cement Co.
 North American Aviation, Inc.
 North American Cement Corp.
 The Ohio Oil Co.
 Owens-Corning Fiberglass Corp.
 Pepperell Manufacturing Co.
 Radio Corporation of America, RCA Victor Division
 Riverside Cement Co.
 Spencer Chemical Co.
 Tide Water Associated Oil Co.
 United States Plywood Corp.
 Virginia Electric and Power Co.
 Warner Co.
 Weirton Steel Co.
 The Western Union Telegraph Co.

The "Sustaining" class now embraces 336 company members who are taking advantage of the incentives offered sustaining members including very liberal publication privileges, and at the same time, through annual dues of \$150, are aiding substantially in underwriting the work of the Society which is vitally significant in the various industrial fields. A list of the 275 sustaining members as of July 15, 1954 begins on page 26 of the Year Book.

Changes in Staff Responsibilities

SOME changes in responsibilities of members of the Headquarters Staff have been effected in recent weeks. John S. Pettibone, Assistant Technical Secretary, is assuming responsibility for the advertising in the ASTM BULLETIN and in the Index to Standards. The BULLETIN is recognized as a very desirable sales promotion medium for companies in the apparatus, instruments, and laboratory supply field as well as for announcements of professional services and new publications and Mr. Pettibone will devote an appropriate portion of his time to stimulating more advertising.

Mr. Pettibone, a member of the ASTM Staff for six years, will continue to carry a number of his other responsibilities, including contacts with the ASTM Districts which he has been handling for over a year, and various technical committee contacts. He will also carry on the work of the Advisory Committee on Corrosion. Mr. Pettibone will, however, need to be relieved of some of his committee contact work.

Fred F. Van Atta, Assistant Secretary, who is responsible for over-all Society promotional and developmental

activities, will continue directly to manage the ASTM Exhibit and handle our public relations and sales promotion activities. In some of these, he and Mr. Pettibone will be cooperating. It is the desire of the Directors that the Society continue to promote the use of its standards wherever feasible and to stimulate the interest of industries and companies which not only can benefit from the work but also help to advance it; and all of this work, including promotion of distribution of our technical books, falls in the office of the Assistant Secretary.

In an announcement appearing in the December issue concerning the appointment to the Staff of Frank Y. Speight, it is indicated that his first responsibilities are staff contacts with Committees D-9 on Electrical Insulating Materials and D-20 on Plastics, relieving P. J. Smith, Standards Editor and Assistant Technical Secretary, whose other responsibilities and activities have increased to a point where some relief was felt desirable. It is expected that there will be other shifts in some of the Staff responsibilities for certain technical committees.

With the Society expanding into new fields and with wider demands for our standards and publications, gradual increases have had to be made in the Staff, which now numbers 70. Every effort is made to mechanize our work, especially the business and records operations, and those responsible are constantly attempting to improve the efficiency of all of our Staff operations.

Papers Committee Meets in February

THE Administrative Committee on Papers and Publications will meet February 14 at which time consideration will be given to the development of the program for the Annual Meeting in June. Quite a number of formal symposiums are in prospect as indicated above, and in addition the Papers Committee has a number of offers that have been submitted individually. While all offers were to be in the hands of the Papers Committee by January 15, any significant contribution which has not been brought to the attention of the Papers Committee should be submitted immediately. It could be that consideration still can be given to such offers.

Schedule of ASTM Meetings

This gives the latest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and location of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

DATE	GROUP	PLACE
Jan. 31-Feb. 4	ASTM Committee Week	Cincinnati, Ohio (Netherland-Plaza Hotel)
Feb. 2-3	Committee C-22 on Porcelain Enamel	Louisville, Ky. (General Electric Co.)
Feb. 8	Southwest District Meeting—Joint with ASM, ASME, Eng. Club of Bartlesville	Bartlesville, Ohio
Feb. 10	Denver District Meeting—Joint with ASM	Denver, Colo.
Feb. 13-18	Committee D-2 on Petroleum Products and Lubricants	Houston, Tex. (Rice Hotel)
Feb. 14	Richland District Meeting—Joint with ASM	Richland, Wash.
Feb. 15	Tacoma District Meeting—Joint with ASM	Tacoma, Wash.
Feb. 16	Seattle District Meeting—Joint with ASM	Seattle, Wash.
Feb. 21-24	Committee D-1 on Paint, Varnish, Lacquer, and Related Products	Roanoke, Va. (Hotel Roanoke)
Feb. 21-22	Committee D-16 on Industrial Aromatic Hydrocarbons, and Related Materials	Roanoke, Va. (Hotel Roanoke)
Feb. 23	Committee E-12 on Appearance	Roanoke, Va. (Hotel Roanoke)
Feb. 23	Northern California District Meeting	San Francisco, Calif.
Feb. 24	Southern California District Meeting	Los Angeles, Calif.
Feb. 24-25	Committee D-6 on Paper and Paper Products	New York N.Y. (ASA Headquarters)
Feb. 28-March 1	Committee E-13 on Absorption Spectroscopy	Pittsburgh, Pa. (Wm. Penn Hotel)
Feb. 28-March 2	Committee D-20 on Plastics	Washington, D. C. (Shoreham Hotel)
March 1	E-2 on Emission Spectroscopy	Pittsburgh, Pa. (Wm. Penn Hotel)
March 1	Southwest District Meeting—Joint with ASM	Houston, Tex.
March 2-4	Committee D-9 on Electrical Insulating Materials	Washington, D. C. (Shoreham Hotel)
March 2-4	Committee C-16 on Thermal Insulating Materials	Savannah, Ga. (General Oglethorpe Hotel)
March 3	Southwest District Meeting—Joint with ASM	Dallas, Tex.
March 9	SAE-ASTM Committee on Automotive Rubber	Detroit, Mich.
March 14-15	Committee D-12 on Soaps and Other Detergents	New York, N. Y. (Park-Sheraton Hotel)
March 14-15	Committee D-7 on Wood	Chicago, Ill. (Palmer House)
March 15-18	Committee D-13 on Textile Materials	New York, N. Y. (Statler Hotel)
March 23-25	Committee D-15 on Engine Antifreezes	Washington, D. C. (Shoreham Hotel)
March 31-April 1	Committee D-14 on Adhesives	New York, N. Y. (ASA Headquarters)
April 21-22	Committee D-10 on Shipping Containers	Madison, Wis. (Forest Prod. Lab.)
April 27-28	Committee C-19 on Structural Sandwich Constructions	Madison, Wis.
June 26-July 1	ASTM Annual Meeting	Atlantic City, N. J. (Chalfonte-Haddon Hall)

District Activities

President Mochel to Visit Midwest and Western Districts

Opportunity for Members to Meet National Officers

AN OPPORTUNITY will be afforded ASTM members in several industrial centers in the Midwest and on the Pacific Coast to meet President Norman L. Mochel and Executive Secretary R. J. Painter. The accompanying schedule of ASTM meetings shows that the two will be in Chicago and St. Louis, January 24 and 25 respectively, and in Cincinnati on February 2. On February 8 they will begin a month's trip which will include ten District meetings, several of which will be held jointly with chapters of the American Society for Metals or other engineering groups.

These will be the first meetings of ASTM members to be held in Bartlesville, Kansas City, Denver, and Seattle. Invitations to attend these meetings will be sent to all ASTM members and committee members in these areas and it is hoped many of them can attend the meetings and greet the two officers.

Many members of the Society do not find it possible to attend national meetings and to meet our fellow members or directors. Whenever an opportunity is presented, the President and Executive Secretary get our members together in industrial centers for a short talk on the work of the Society and for fellowship. Frequently such meetings are sponsored by ASTM districts; in other cases they are arranged through the interest of two or three of our members serving on an informal committee.

ASTM work in materials research and standardization is technical, requiring intensive effort on the part of representatives of industry and Government. Its outstanding success reflects this intensive work. However, there is occasionally an opportunity to meet when technical problems are not on the agenda, and these occasions have much to commend them.

NEW YORK

WESTERN NEW YORK-ONTARIO

PRESIDENT Norman L. Mochel and Executive Secretary Painter were enthusiastic about the fine meetings that were arranged in Rome by the New York District and in Buffalo, N. Y., by the Western New York-Ontario District on December 8 and 9 and also were pleased at the opportunity to discuss the work of the Society with officials of General Electric Co. in Schenectady. The District meetings were sponsored jointly with the Rome and Buffalo Chapters respectively, of the American Society for Metals.

Each meeting was preceded by a cocktail hour and dinner—in Rome at the Elks Club and in Buffalo at the Hotel Sheraton.

Following a short coffee address by Executive Secretary Painter on the subject "Cooperation in Materials Research and Standards," during which he pointed out a few case histories of how ASTM and other societies and trade groups cooperate in developing important data and translating this into needed standard specifications and test methods, President Mochel gave his District address "Power and Materials, Now and in the Future." As at previous meetings, this illustrated address created much interest. Some details have been given in a previous BULLETIN and it is expected the address will be published in one of the 1955 issues.

In Rome, ASTM Vice-President R. A. Schatzel, Rome Cable Co., made arrangements for the meeting in cooperation with the officers of the ASM Chapter which included Max Howard, Chairman, Oneida Limited; E. E. Grider, Vice-Chairman, Utica Drop Forge & Tool Corp.; and John F. Pietras, Secretary and Treasurer, Revere Copper & Brass, Inc. There were a goodly number of ASTM members and committee members present, including Messrs. T. S. Fuller and George H. Harnden from Schenectady and Dr. R. A. Wilkens, Vice-President, Revere



At the Buffalo meeting of the Western New York-Ontario District. Left to right: Raymond Griffenhagen, local ASTM chairman; ASTM President Mochel; ASTM District Chairman Fred A. Webber.

New York District meeting at Rome, N. Y. Seated, left to right: ASTM Past-President T. S. Fuller; ASTM President N. L. Mochel; Chairman Max Howard, Rome Chapter, ASTM. Standing, left to right: ASTM Vice-President R. A. Schatzel; Vice-Chairman Ernest Grider, Rome Chapter, ASTM; and ASTM Executive Secretary R. J. Painter.



Photo courtesy Rome Daily Sentinel

Copper and Brass, Inc., an active ASTM member.

In Buffalo, District Chairman Fred A. Webber, The Colorado Fuel and Iron Corp., Wickwire Spencer Steel Div., and Secretary Clarence Lamoreaux, The Federal Portland Cement Co., Inc., collaborated with the ASTM Chapter officers which included Raymond Griffenhagen, Chairman, Westinghouse Electric Corp.; Silas Brown, Vice-Chairman, Bethlehem Steel Co.; Emil M. Galbreath, Secretary, Hobart Welder Sales & Service; and Matthew N. Hayes, Treasurer, Dustex Corp.

There were about 100 in attendance at the Rome meeting and just over 90 in Buffalo. Rome greeted the Society officers with a new 6-in. snowfall and Buffalo washed away its snow with a heavy rain, followed right after the meeting with a howling blizzard.

Schenectady

Through the interest of George H. Harnden, Supervisor, Materials and Processes, Engineering Standards Dept., General Electric Co., the two officers attended a dinner meeting with a number of managerial and department heads of the General Electric Co., including Messrs. Richard Cutts and H. W. Robb, officials of the Engineering Standards Dept. Case histories were given briefly by the officers, indicating work newly started or contemplated in ASTM, examples of ASTM contributions to industry in both the research and standards phases, and a review of the mutual interests of General Electric and ASTM.

During the trip, Messrs. Mochel and Painter had the opportunity to inspect the tremendous turbine plant of General Electric at Schenectady, their General Research Building, and the new Metallurgical Pilot Plant nearing completion. In Rome visits were made to the Revere Copper research laboratories and the laboratories and plant of Rome Cable Corp. In all of these places they were impressed with the great interest in materials.

NORTHERN CALIFORNIA

The Northern California District of the ASTM turned out *en masse* to hear Dr. Hans Friedrich's presentation of "Rocketry in the Past and Future," as presented before a joint meeting of the ASTM, ASME, and American Rocket Society at the Engineers Club in San Francisco on November 30.

Dr. Friedrich's talk traced the history of rockets from their first appearance in China in the 13th century until the interplanetary trip of the future to Mars—competition of rockets with fire arms during the Middle Ages and the reasons why rockets lost this competition due to lack of correctly understanding the basic principle of rocket propulsion; revival of the rocket idea for space travel as outlined by Jules Verne in the 19th century as a consequence of Sir Isaac Newton's law of "Action and Reaction;" advancement in development in rocketry after World War I; and the German V2 as an example of modern large-scale rockets. First associated with the Research Institute of the German General Electric Co. in Berlin, he was from 1939 through 1945 stationed on the island of Usedom with the German Rocketry Center Peenemuende. In the period following the war until his association

in 1951 with Consolidated Vultee Aircraft Corp., he was engaged in general research work in the field of flight mechanics and control of guided missiles.

Over 400 members and guests were present to hear Dr. Friedrich, and more than one-third of this number were present for the dinner preceding the technical session.

Pertinent remarks were made by the representatives of the various groups including F. W. Beichley, Vice-Chairman, ASME San Francisco Section; Mr. Eggers of the American Rocket Society; and Harry P. Hoopes, Chairman of the ASTM Northern California District. Mr. Hoopes introduced Dr. Friedrich whose interesting talk extended over more than an hour, followed by some 35 minutes of discussion.

Since the natural colors of clay products are, with few exceptions, mixtures of shades rather than pure colors, the accepted practice in specifying color for brick and tile is to require the shipment to match an approved sample.

Technical Committee Notes

Copper and Copper Alloys

Committee and Six Subgroups Meet in Washington

THE regular fall meetings of Committee B-5 were held October 5 and 6 at the Sheraton Park Hotel in Washington, D. C., at which time six of the subcommittees as well as the main Committee B-5 convened.

Plate, Sheet, and Strip.—In those specifications for copper and copper-base alloy plate, sheet, and strip where tension or bend-tests are specified, explanation will probably be added that the test specimens shall have their longitudinal axis parallel to the direction of rolling. In Specification B 171 for condenser tube plates, provisions are proposed for one tension test for each 5000 lb of material or for each plate if the weight of one plate exceeds 5000 lb. In Specifications B 19, B 100, B 130, B 171, and B 248 the clause explaining rejection for exceeding dimensional tolerances will probably be deleted and a new wording adopted which includes details of instrument accuracy and graduation.

Rod, Bar, and Shapes.—A 10 per cent and a 12 per cent nickel silver alloy are proposed for addition to Specification B 151. Specification B 124 for copper and copper-alloy forging quality rod, bar, and shapes has a number of revisions planned including (1) deletion of alloys 5, 6, 8, 9, and 10; (2) addition of names for remaining alloys; (3) new copper limits for alloy 2 (forging brass) of 58.0 to 61.0 per cent; (4) addition of straightness tolerances; and (5) in the Appendix reference to Specification B 283 for typical tensile values and forgeability ratings. New details for instrument accuracy and graduation for measuring dimensions are also planned for Specification B 249.

Wire and Wire Rod.—As planned for Specification B 248 (plate, sheet, and strip) and B 249 (rod, bar, and shapes) a new clause explaining rejection of wire and wire rod for exceeding dimensional tolerances, including details of instrument accuracy and graduation, will probably be added to Specification B 250.

Pipe and Tube.—In the specifications which include an expansion or flattening test, a definition of failure to meet such tests will probably be added. Test Method B 153 will also be revised in accordance with the definition to be included in the specifications. Several years ago Specification B 188 for bus pipe and tube was made dependent on Specification B 250 for dimensional tolerances, etc. Both specifications are now being surveyed for the revisions necessary to make Specification B 188 a complete document. In Specifications B 13, B 111, B 151, B 251, and B 280 revised wording covering rejection for dimensional tolerances and describing the instruments to be used is scheduled for addition.

Classification of Wrought Alloys.—After much discussion in the committee it appears that the Proposed Classification of Wrought Copper-Base has been cleared for recommendation for publication as tentative in 1955.

Technical Papers.—At the next series of meetings of Committee B-5 (January 19, 20, 1955) in New York City, G. H. Bohn of the Linde Air Products Co. will present a paper on tensile strength *versus* analysis of the copper-silicon-manganese-iron alloy via a mathematical formula. Planned for the fall 1955 meeting is a paper by G. R. Gohn, Bell Telephone Laboratories, on effects of varying proportions of tin and phosphorus on the tensile, fatigue, and other properties of phosphor bronze alloys.

Wires for Electrical Conductors

Work on Conductors Progressing

USING the Sheraton Park Hotel in Washington, D. C., Committee B-1 and several subcommittees met on October 25 and 26. The subcommittees covering copper and copper-alloy conductors and aluminum conductors reported much progress in task group assignments.

Copper and Copper Alloys.—The trolley wire gages published for several years as information and investigation

purposes will probably be incorporated into Specifications B 9, B 47, and B 116. Task groups reported as follows:

1. Data are being collected so that statistical sampling procedures can be incorporated in Specifications B 33, and B 189, covering tinned and lead-coated conductors.

2. Data for specification values for stiffness requirements of magnet wire are being collected and studied.

3. Additional strandings for Specifications B 286 covering electronic hook-up wire are under discussion.

4. Considerable progress has been made on the preparation of proposed specifications for coated wire for high-temperature applications.

5. The investigation of methods of calculating derived data for shaped wire is well under way.

6. Addition of a new 30 per cent conductivity alloy to Specifications B 105 is being considered. At present the question of stress-corrosion resistance of the new composition is under review.

Aluminum Conductors.—A report on the September meetings of Technical Committee 7 (Aluminum) of the International Electrotechnical Commission in Philadelphia was given. At those meetings, which had a large U. S. delegation in attendance, tentative agreement on a standard for annealed high-purity aluminum (resistivity $\frac{1}{37}$ ohm, approximating 63.8 per cent IACS) was reached. Also tentative agreement resulted on a minimum conductivity of 61 per cent IACS for hard-drawn aluminum wire.

Discussion of other subjects disclosed the following:

1. The listed ACSR constructions in Specifications B 232 are being studied with a view toward deleting some and adding others.

2. Several producers reported promising results with the new cold welding process for joining aluminum wire. Observations will continue.

3. Correlation of diameter tolerance requirements for small wire sizes of aluminum and copper conductors is being studied.

Acoustical Materials

First Standards Readied

THE acceptance of final drafts of several proposed standards by Committee C-20 on Acoustical Materials marks the culmination of five years' effort in the preparation of the first ASTM standards in the field of acoustical materials. The committee took this action at its fall meeting held at Columbia University, New York City, on December 1 and 2.

Three important standards, which will now be sent to letter ballot of the subcommittee and then to the main committee for inclusion in the 1955 Book of Standards, include a proposed specification for adhesives used in the application of acoustical tile, a tentative method of test for determining impedance and absorption of acoustical materials by the tube method, and tentative methods of tests for measuring the structural properties of architectural acoustical materials.

The specification for adhesives will first be coordinated with Committee D-14 on Adhesives through a special joint task group. One problem which has retarded the completion of the specification has been the inclusion of an aging test requirement, for which there have been no available procedures or data. A round-robin test series is planned, by which four samples of adhesives will be distributed by each member of a special task group to collect data on the proposed aging test, which is now included in the specification. The problem of the effect of mechanical suspension of acoustical tile was discussed, indicating the need for physical tests and possible specifications.

The tube method for measuring sound absorption is a comparatively simple and rapid technique which will provide absolute measurement of the normal incidence sound absorption coefficient and the specific normal acoustic impedance of a material. Two other methods of determining sound absorption are also being considered in subcommittee, one being the reverberation chamber method. This is the most generally accepted method but is relatively expensive and time consuming and involves a large specimen and elaborate facilities. A standard sample is being prepared for further cooperative tests, particularly in the field of higher frequencies, before this method will be ready for acceptance. A draft of a test procedure involving the box method is expected by the time of the next meeting.

The determination of structural properties of acoustical materials will in-

clude the measurement of structural hardness, friability, sag, transverse strength, and linear expansion and contraction.

Considerable attention was given to the subject of fire resistance tests. It was the consensus of the subcommittee concerned with this phase that a proposed panel test, which has been in the process of development, be completed after reconciling it with the method as prescribed in Federal Specification SS-A-118b. Coordination will be effected with the National Bureau of Standards through a special task group. The committee will maintain its interest in the progress and results of the research being conducted at the Forest Products Laboratory on the development of a small-scale tunnel test.

Because maintenance is an all-important feature in the use of acoustical materials, the washability and discoloration properties have been under consideration for some time. At the meeting of the Subcommittee on Maintenance, it was resolved that a cleansability test was much more significant than a washability test, the latter being too severe a test. The development of a cleansability test method was given first priority, and it is hoped to have a draft available for the next meeting. A test program at the National Bureau of Standards, sponsored by the Public Buildings Administration, on the staining and discoloration susceptibility of acoustical tile due to breathing and impingement will be followed closely. The development of a paintability test was discussed at some length. Preliminary tests will be run, using the latest draft of a method involving increase in light reflectance and the effect resulting in decreased sound absorption through application of paint.

Foamed Plastics Subject for Study Group

C. H. ALEXANDER of B. F. Goodrich Chemical Co. has been appointed by Professor R. K. Witt, Chairman of Committee D-20 on Plastics, to head a Study Group on Foamed Plastics. This group will survey the interest among producers and consumers of foamed plastics to determine whether or not Committee D-20 should be concerned with test methods and specifications for such materials. Foamed plastics are being used increasingly for such diverse applications as thermal insulation, core material for sandwich construction, toys, novelties, and advertising displays.

Electrical Insulating Materials

Transformer Oil Symposium Highlights Meeting

THE meeting of the joint (with Committee D-20 on Plastics) Subcommittee on Conditioning held on November 17 at the Hotel Carter in Cleveland marked the beginning of the three-day meeting of Committee D-9 which also included a Symposium on "European Developments in the Testing of Transformer Oil" held on the evening of November 17.

There are a number of other cooperative activities of the committee with other groups including the American Institute of Electrical Engineers, the International Standards Assn., and the International Electrotechnical Commission, as well as several other committees of the ASTM. At the Cleveland meeting, representatives for these other groups were appointed from the D-9 membership to fill vacancies from resignations or expired terms.

Subcommittee I on Insulating Varnishes recommended certain editorial changes in the specification for shellac (D 748) to bring it more in line with a similar specification of the surface coatings Committee D-1 (D 273).

Subcommittee V on Ceramics was reactivated and E. J. Smoke of Rutgers University was appointed chairman. It was agreed that the subcommittee would concern itself only with electrical properties of ceramic materials leaving other than electrical considerations to committees on Ceramics (C 21) and Glass (C 14).

The committee approved the revised specification for Laminated Thermosetting Plastics (D 709) and recommended it for submission to the Standards Committee subject to approval by Committee D-20 on Plastics which holds joint jurisdiction.

A revision of the Methods of Testing Pasted Mica Used in Electrical Insulation (D 352) is to be printed in the D-9 compilation for information. A major revision of these methods is in progress.

Subcommittee XII on Electrical Testing recommended for committee ballot a revision of the dielectric strength method (D 149). It was reported that the new section I on Corona Testing has defined the scope of operations and is making progress. A symposium on corona was planned for a meeting in 1955, the details to be worked out later. The meeting scheduled for early March, 1955, in Washington, will feature a symposium on electrodes for electrical testing.

Tentative plans for other symposiums

to be held at subsequent meetings into 1956 were made and members were alerted regarding contribution of papers.

Symposium Reports European Developments in the Testing of Transformer Oils

THIS symposium was the sixth in a series on transformer oils, the fifth having been held in 1952 (*STP 152*) and the fourth in 1951 (*STP 135*). L. B. Schofield, Chairman of the Symposium Committee of Subcommittee IV on Liquid Insulation presided, introducing the speakers and leading the discussion.

The program consisted of three papers which reported research on the subject in France, Sweden, and England. Although two of the authors were not able to present their papers in person, it was fortunate that there were two members of the committee who were willing to read the papers and to endeavor to present the authors' point of view during the discussion. Titles of papers are as follows:

- The Performance Characteristics of Used Insulating Oils by T. Salomon (France)—paper read by F. M. Clark.
- Catalysts for Accelerated Aging Testing of Transformer Oil by H. Liander and G. Ericson (Sweden)—paper read by E. R. Thomas.
- The Evaluation of Inhibited Transformer Oils by R. Irving and D. W. Bravey (England)—presented by D. W. Bravey.

A number of questions were raised during the discussion, particularly with regard to the use of various forms of copper to accelerate sludge formation. So that the point of view of the absent authors may be presented fully in the printed publication, a transcript of the discussion will be sent to them for their written comments.

This sixth series of papers on transformer oils represents a notable addition to the literature in this important field and credit is due L. B. Schofield for his efforts in arranging the program and to others who assisted him. Special thanks are owing to the authors who made available the results of their research for presentation at the symposium.

An announcement of the availability of the published proceeding will appear in a future issue of the BULLETIN.

Plastics

Cleveland Is Host to Committee D-20

THE "June in January" weather that greeted the Plastics Committee on November 15-17 at the Hotel Carter in Cleveland came as a welcome surprise to those who had expected the worst. To most, however, a busy meeting left little time to enjoy the unusual weather or other advantages Cleveland might have offered.

The committee had previously approved a revision of the Tentative Methods of Test for Tensile Properties of the Plastic Sheets and Films (D 882) and at this meeting it was revealed that the Tentative Method of Test for Tensile Properties of Plastics (D 638) should be modified to allow higher speeds of testing for certain thermoplastics which because of their elongation characteristics require excessive time for a single tension test. Steps are being taken to determine the effect of higher testing speeds on the tensile values in related specifications for thermoplastics.

Subcommittee III on Thermal Properties has recently completed a round robin on the SPI method for determining flammability. Results indicated that the method requires further improvements before it can be submitted for consideration as a standard. A method for determining flow of thermoplastics by the parallel plate plastometer is ready for section ballot. This development is of particular interest because of recognized deficiencies in the extrusion plastometer (D 1238) for certain thermoplastics particularly polyethylene.

Subcommittee XVII on Plastic Pipe organized eight sections, appointed chairmen, and held organization meetings to outline the scope of operations. Similarly, Subcommittee XVIII on Reinforced Plastics organized five sections. Other recently organized Subcommittees on Thermoplastics, Thermosetting Resins, and Plastic Film and Sheeting take the place of the former Subcommittee V on Specifications.

The Reinforced Plastics Subcommittee voted to submit to Committee D-20 letter ballot a revision of the Tentative Specification on Laminated Thermosetting Materials (D 709). The revision has already been approved by Committee D-9 on Electrical Insulating Materials which holds joint jurisdiction.

A report was presented on the activities of the Technical Committee on Plastics of the International Standards Organization (ISO/TC 61). Details appear on page 21 of this issue.

A Study Group was appointed by the

chairman to survey the need for work on foamed plastics and to make recommendations to the D-20 Advisory Committee.

In order to improve the proportions of consumers to producers, particularly in the newly organized subcommittees, the chairman appointed a Study Group on Membership to make recommendations to the D-20 Advisory Committee.

Wax Polishes

Work Planned in Solvent-Type Floor Waxes

For the past few years this committee has concentrated its work on water-emulsion of floor waxes. However, interest in solvent-type floor waxes and waxes for other than floor application expressed at the midyear meeting in New York, December 9, and 10, 1954, has made necessary a broader scope of subcommittee activity which is presently under way. The committee is making an appeal to all those connected with the wax industry to assist in this project by sending to the chairman methods which are felt to be of value to a particular individual or organization.

A thorough review of words whose definitions are peculiar to the wax polish industry is now under study by Subcommittee I on Definitions. The subcommittee hopes that suggestions from all quarters of the industry will permit an early publication of a tentative list.

Three methods, which are of use in determining significant properties of raw materials for wax polishes, have been circulated in Subcommittee II on Raw Materials, and are receiving final review by the subcommittee: acid number; saponification number, and the acid and ester determination of raw wax materials.

Three samples of wax were sent to each of four laboratories for collaborative tests in regard to a reduction of oven time and temperature for the revision of the Tentative Method for Determination of Total Solids (D 1289). The results of this series of tests were so successful that the Task Group undertaking this test series has recommended that the drying time be reduced from 6 to 4 hr and that the oven temperature be changed from 105 to 110 C, to 105 \pm 2.5 C. One of the most difficult methods to be undertaken by Subcommittee III on Chemical and Physical Testing, has been a short-time test which will give a valid indication of stability. In an effort to establish a method of measuring stability, the com-

mittee has asked that all such methods currently used be available for review.

In connection with the work on slipperiness, an effort to produce a secondary standard which can be made to more reproducible tolerances than the tentative official test linoleum is under investigation with an interlaboratory test program for evaluating a ground glass plate. This plate is being tested under specific conditions with both the James and the Sigler machines which measure the coefficient of friction of waxed surfaces. The proposed method of test for water spotting of emulsion floor waxes received critical review at the meeting with several revisions suggested to increase its validity.

A series of attributes of the appearance and application of applied waxes has been presented as an outline of the work program for the future. This list includes: gloss measurement, dirt retention, abrasion and buffability, color, and leveling and spreading.

A great deal of time and thought has been devoted to preparing a specification for general purpose floor waxes. The Specification Subcommittee has made a major effort in preparing such a specification, but it is expected that definitions and methods necessary in the support of this specification will take the concerted effort of the entire committee for some time.

Quality Control of Materials

Sampling Provisions in ASTM Standards Surveyed

COMMITTEE E-11 met at Society Headquarters in Philadelphia on November 16, preceded by a meeting of the Advisory Committee.

The Task Group on Sampling Plans reported that a summary had been prepared covering the various sampling provisions in a large number of ASTM standards. This summary will make evident the variations that now exist, and attention will be directed to ways and means in which the standards can be improved in respect to their sampling provisions. It is expected that this report will be published in the ASTM BULLETIN after review and approval by the committee.

A new Tentative Recommended Practice for Probability Sampling of Materials (E 105), which was prepared by the Task Group on Bulk Sampling, has just been accepted by the Society and is being published in Parts 3, 4, and 6 of the 1954 Supplement to Book of ASTM Standards. Probability sampling is defined as a procedure that follows rigidly the theory of probability

for the selection of the items for test and for the inferences drawn from the tests. No one procedure is correct, to the exclusion of all others. Instead, for any given set of conditions, there will usually be several possible plans, all valid, but of differing degrees of speed, simplicity, and cost. The aim of this recommended practice is to present principles for guidance in the preparation of a sampling procedure for a specific material. It is believed that this recommended practice on probability sampling will be of immediate interest to many technical committees of the Society. Separate copies are accordingly being printed and will be distributed to the officers of all Society committees. Consideration was given to the subject of acceptance sampling, and it was decided to undertake a study of the type of such sampling plans now in use as a basis for considering the possible establishment of a task group on this subject.

The Task Group on Smoothing Empirical Data has completed a study on linearizing trends. To compile necessary information and complete this project would require research study. Funds are now being sought for this project.

The proposed recommended practice for conducting an interlaboratory study of a test method is still under consideration in the originating task group. Effort will be made to complete this recommended practice prior to the next meeting of Committee E-11.

The write-up on "Choice of a Sample Size for a Desired Precision of an Average" which was prepared by Task Group 6 is now under study by the Advisory Committee. After approval by Committee E-11 it is intended that this will be published as part of the ASTM Manual of Quality Control of Materials.

The first draft of a write-up on "Design of Experiments" has been completed and is now being reviewed by the task group on this subject. This draft presents in some detail, with examples, the Randomized Block, the Latin Square, and the two-factor factorial experiments. It is believed that the idea is important in design of experiments and can be developed around the examples included in these recommendations. References have been included to more elaborate block designs and the ramifications of factorial experimentation. After completion and approval by the committee, this subject will be published as part of the ASTM Manual of Quality Control of Materials.

The first draft of a write-up on "Design of Experiments" has been completed and is now being reviewed by the task

group on this subject. This draft presents in some detail, with examples, the Randomized Block, the Latin Square, and the two-factor factorial experiments. It is believed that the idea is important in design of experiments and can be developed around the examples included in these recommendations. References have been included to more elaborate block designs and the ramifications of factorial experimentation. After completion and approval by the committee, this subject will be published as a part of the ASTM manual.

The new Task Group on Legal Tolerances has the general assignment of covering all types of products at all levels of transfer of ownership. While specifications, and therefore tolerances, are generally unique to a product, there are classifications that probably can be established. One which appears to cut across all product types is the consequence of nonconformity. It is proposed to establish objective scales for relating the various types of consequences to proper levels of probability or risk. This would be done empirically at the preliminary level. It is then proposed that material concerning court actions involving any matters relating to nonconformity of product specifications, warranties, or other legal types of guarantee be collected from whatever sources are available. A digest of such cases from the viewpoint of their statistical applications would then be matched to the empirical curves to form a basis for adjustment to existing procedures. At this point, the complete evidence of the investigation would be submitted for review for whatever action is warranted by Committee E-11.

The Subcommittee on ASTM Problems now includes in its personnel representatives from 30 technical committees of the Society. Several projects have been presented to the subcommittee which has resulted in the appointment of *ad hoc* committees to review and advise on the problems presented.

Shrinkage Characteristics of Concrete Masonry Walls

THE results of a comprehensive study on shrinkage and other characteristics of concrete blocks when laid up in mortar to form masonry walls are reported in *Housing Research Paper 34*, published by the Housing and Home Finance Agency. Believed to be the most extensive single piece of research to date in the field of concrete masonry construction, the 57-page report may be purchased for 40 cents from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Random Samples . . .

FROM THE CURRENT MATERIALS NEWS

From the broad stream of current materials information flowing from "in-box" to "out-box" in a busy editorial office, random samples (mostly random) have been plucked. Thinking them worth re-showing to ASTM'ers who may have missed the original articles, we have included them here. Of course, we had to trim the samples to fit. There will be those who are not satisfied with samples, especially ones which are not really random. But these ASTM'ers can contact the institution, magazine, governmental agency, etc., who placed the original information in the stream. We have quoted literally, sometimes without quotation marks where the point of omission is obvious, and we have given credit to the source. These credit lines are also for the use of ASTM'ers whose entire curiosity has been aroused.

Measuring Water Vapor Permeability

WATER VAPOR permeances of thermally insulated panels can be measured by means of a newly designed apparatus, according to the National Bureau of Standards. Constructed for the Quartermaster General, the apparatus will be used to obtain criteria for designing refrigeration warehouse panels not subject to damage due to internal condensation of moisture. Measurements of heat flow provide an indication of the effect of moisture accumulation on over-all insulating value. Direct measurements of vapor flow into and out of the panel are made by absorbing the water vapor by a desiccant.

Tungsten and Molybdenum Metal Products

GENERAL Electric Co. has announced plans to make its pure tungsten and molybdenum products generally available on the open market. These products in the past have been applied outside the company only to a limited extent.

G.E.'s Cleveland Wire Works, with its subsidiary plant at Dover, Ohio, produces and markets these pure metals in the form of powder, rod, wire, rolled sheet, and fabricated products.

To facilitate further its efforts to develop new tungsten and molybdenum products, and to improve existing ones, General Electric is building a \$1,700,000 laboratory-pilot plant on the property of the Cleveland Wire Works. The structure is expected to be completed late next summer.

Family Trees

THE science of genetics is an increasingly important ally of forestry. The United States Forest Service is greatly expanding its work in this field, started with limited funds 20

years ago. Other agencies, such as associations of foresters, wood producers and users, and universities are conducting successful field and laboratory research on the development of better forest trees.

Selection is one way of improving tree stock; about three fourths of commercial U. S. woodlands are regenerated naturally from seed trees left standing. By selecting the most desirable trees for seed, or leaving blocks of vigorous or otherwise desirable trees when complete cutting is necessary, and by culling least desirable trees when thinning the second growth, the quality of the stand may gradually be improved.

When planting is necessary, nursery stock from selected seed trees is desirable. State nurseries and those operated by owners of large forest areas are concentrating increasingly on producing high-quality seed from known sources. Although this is an important and valuable initial step, improvement is limited to the best of the wild trees.

Tree breeding, while more expensive and time-consuming than selection, permits creating entirely new combinations of genes; some of the trees thus produced may be superior to the naturally occurring types. Work to date indicates that disease-resistant trees, or those with high yield or other special characteristics may be bred to order, as has been done for corn and other crop plants. Hybrids are produced by control of pollination, accomplished through bagging the female flowers of a superior tree and introducing pollen from another desirable tree into the bag. The hybrid offspring often inherit and may benefit from the desirable characteristics of both parents. Superior trees, either found in the wild or produced through breeding, may be propagated by vegetative techniques, such as grafting, budding, or rooting. The "offspring" are then genetically identical with the superior parent.

The Institute of Forest Genetics in California has produced nearly 80 hybrid types of pine. Some of these show

great resistance to bark beetles and the pine blister rust; others have large-diameter stems, and fewer, smaller branches than the parent trees. Similar work on poplars has produced vigorous trees, resistant to many diseases and adapted to a harsh climate.

There are now only about 700,000 square miles of commercial land suitable for growing timber in the United States, but if all this land were fully stocked, it could supply the total U. S. demand for forest products. About 49,000 square miles are devoted to tree farming, where the forest tract is managed in accordance with high standards of forestry, with protection from fire, insects, and other destructive agencies, and provision for either natural or artificial regeneration, for permanent and continuous timber production. Second crops, however, may require 30 to 100 years to develop, depending on the species and the end use, before they are ready for harvesting. About 117,000 square miles are denuded or poorly stocked, and will probably require planting to bring them back to productive condition. For such areas, the genetically improved planting stock supplied by the tree breeder may be expected to increase markedly the quality and yield of the raw materials produced.

Industrial Bulletin
Arthur D. Little, Inc.
October, 1954

Tree-Grown Rubber Reproduced Synthetically

AMERICAN scientists have finally succeeded in reproducing the true molecule of crude, or tree-grown rubber, a major scientific achievement. The successful reproduction of crude rubber synthetically has been a goal of world scientists for generations. It has also posed a problem in the self-sufficiency of the United States, because although it is the world's largest consumer of natural rubber, it has had to import

every pound used from the Far East, South America, or Africa.

The actual discovery was made in the B. F. Goodrich Research Center, Brecksville, Ohio, by a research team assigned to the project by Goodrich-Gulf Chemicals, Inc. Joint teams of scientists in both Gulf and B. F. Goodrich laboratories have long been at work using a new approach to the challenging assignment.

The new rubber is made from different materials than those used in GR-S synthetic rubber and could not be produced in presently existing Government-owned synthetic rubber plants.

Based on the best estimates that can be made at this early state of development of the discovery, the cost of the new material in commercially important volume would be substantially higher than the present price for GR-S rubber.

GR-S rubber is a very valuable material and is better for many uses than crude, or tree rubber. However, there is an area of usage where crude rubber is the preferred material, apart from the economics of the two materials. This usage embraces truck and airplane tires and today accounts for about 30 per cent of the total annual tonnage of the new rubber consumed in the United States.

GR-S rubber in tires under heavy loads generates more heat than crude rubber, freezes at higher temperatures, and in its uncured state is not as tacky, or sticky, as crude rubber. In all tests made to date, the newly-discovered man-made rubber possesses the physical properties of crude rubber even to tack and stickiness. GR-S man-made rubber has its own wide area of usage where it is the best material, notably for treads in passenger car tires.

Although the new material can be used to replace crude rubber, the fact that it can be made will not make rubber plantations obsolete. This is true because tree rubber can, on the more efficient plantations, be produced for a much lower cost than the presently indicated cost of the new material. However, the new man-made rubber when in production will in effect place a ceiling on the price of crude rubber.

Wrought Iron Tubing Available

A. M. BYERS Co. is actively marketing for the first time corrosion-resistant cold-drawn wrought iron tubing manufactured to precise tolerances for installation in heat transfer apparatus and air conditioning systems. First installations of cold-drawn wrought iron tubing began in 1946. An analysis of results to date has

proved the product's merit under actual operating conditions in a broad field of applications.

Specific services in which the tubing's resistance to corrosion and fatigue failure help reduce the frequency of repair or replacement include: ammonia condensers, heat exchangers, preheaters, gas cooling apparatus, gasoline condensers, evaporators, vaporizers producing Butane and Propane gas, cooling pipe and steam condensers. The new cold-drawn tubing is especially suitable for handling salt and brine solutions in air conditioning systems.

Wrought iron tubing is manufactured to closer dimensional tolerances than wrought iron pipe. In actual physical characteristics, however, wrought iron tubing and pipe are similar—each providing identical protection against corrosion and fatigue failure.

Like wrought iron pipe, the cold-drawn tubing is comprised of high-purity iron and iron silicate in physical rather than chemical association. The iron silicate—a type of glass-like slag—occurs in threadlike form throughout the high-purity iron. This combination gives the metal a strong, hickorylike structure and the slag fibers, numbering some 250,000 per square cross-sectional inch, disperse the attack of corrosive forces and prolong the life of the tubing.

Physical properties of the tubing conform to those listed for welded wrought iron pipe in ASTM Specifications A 72. Cold-drawn wrought iron tubing is presently available in sizes ranging from $\frac{3}{8}$ to $3\frac{1}{2}$ in. in outer diameter and in 14 to 8 gage thickness. It is supplied in lengths according to the specifications of the customer. Due to the diversity of customer requirements with respect to outside diameters, gages, and lengths, the new tubing is produced only in quantities adequate to fill definite orders.

Rough on Rails

ELECTRONIC tests of track of Canada's new Quebec, North Shore, and Labrador Railroad by Sperry Rail Service, of Danbury, Conn., were recently made to ascertain condition of the rails after several months of some of the world's most severe operating and weather conditions.

The tests involve inspection of new-type control-cooled rails laid just before the line began operating last July and subjected both to concentrated freight traffic, low temperatures, and unstable foundations. Some 60 miles of the line, which extends 356 miles between tide-

water Seven Islands, Quebec, and Schefferville, Knob Lake, Labrador, are laid over sand, gravel, and rock fill on swampy muskeg. The rest of the track is on solid fill, follows rivers, and cuts through mountain ranges.

The newness of the railroad, the heavy freight traffic it carries, and the severity of the weather are regarded as combining to provide one of the most severe possible tests of the new control-cooled rail. Its use is consistent with the objective of designing the QNS & L for the heaviest trains constantly operated on any railroad. Diesel-drawn at 40 mph, they carry 14,000 tons of iron ore from 26 shallow deposits estimated at 417,000,000 tons.

The road, built with the continuing advice and interest of American railroad engineers, is owned by the Iron Ore Co. of Canada, which is largely owned by the M. A. Hanna Co., of Cleveland, Ohio, and Hollinger Consolidated Gold Mines. Rolling stock comprises 50 diesel locomotives and 1800 freight cars, mainly gondolas. Operating plans call for the transportation of between 10,000,000 and 20,000,000 tons of iron ore during the mining season of five to six months. Three diesel locomotives haul each 100-car loaded train.

NYU Air Pollution Course

A COURSE in Air Pollution is being offered for the second year by the Institute of Industrial Medicine of the NYU Post-Graduate Medical School, a unit of New York University-Bellevue Medical Center, in cooperation with NYU College of Engineering.

This year's course, scheduled from February 10 through May 26, 1955, will meet once a week for fifteen weeks (Thursday, 4 to 6 pm) in order to permit those employed in the New York metropolitan area to participate without disrupting their schedules.

The course has been designed to acquaint industrial hygienists, stationary engineers, chemical and power plant engineers, safety engineers, insurance engineers, health officials, and others having responsibility for air pollution control, with the fundamentals of the measurement and prevention of atmospheric pollution.

Application should be made through the Office of the Dean, New York University Post-Graduate Medical School, 550 First Ave., New York 16, N. Y.

Iced Piping

Much information on piping in ice rinks was brought to light recently by questionnaires mailed to owners or managers of all United States and Canadian rinks with artificial ice installations, other than small studio rinks. Detailed replies were received from 52 U. S. rinks and 60 Canadian rinks, including a number of the largest in each country.

Piping in ice rinks, if properly installed and maintained, is giving long dependable service. Corrosion, once a bugaboo to rink owners, seems to be under control.

Piping installed 20 or more years ago is still giving satisfactory service. A majority of the installations reported were of steel pipe, followed closely by wrought iron pipe, both of which showed long service records.

Most of the pipe used is of either 1½-in. or 1-in. diameter. A separation of 4 in. between centers is used in half of the rinks that submitted reports, with the separations in other cases ranging from 2 to 8 in.

In all but a few cases, the lengths of pipe are welded together, rather than being attached by threads and couplings. Most of the pipe is uncoated. Brine is overwhelmingly favored over ammonia and other refrigerants. In most cases a corrosion inhibitor is used in the brine.

The greatest variation indicated in both countries is in the types of bases used. These range from simple installations, with the pipe resting on sleepers and covered by sand, to those using a variety of materials in carefully planned successive layers.

Concrete is used in one way or another in the bases of more than half of the United States rinks, but only about one quarter of the Canadian rinks. Sand, with or without other materials, is used by more than half of the Canadian rinks. Other materials used in both countries include cork, cinders, gravel, crushed stone, and asphalt.

The survey was conducted for the Spang-Chalfant Division of The National Supply Co., in order to obtain information that might help each rink get the maximum service from the pipe used.

West Coast to Feature World Plastics Fair and Trade Exposition

In keeping with the large and rapidly expanding production and demand for plastics in the western states, the various plastics interests in the coast area are holding a Fair and Exposition from April 6 to 10 at the National Guard Armory, Exhibition

Park, Los Angeles, Calif. Although this is to be primarily a trade show, consumer audiences will be permitted to attend at certain specified times.

Assisting Consolidated Advertising Directors, managers of the show, is an advisory board which includes among its members: Jesse H. Day, Editor of the *SPE Journal* (Society of Plastics Engi-

neers); Austin Herbst, President, Southern California section SPE; Felix Karas, Publicity Chairman, Southern California section SPE; Samuel S. Olesky, Micronics, Inc. and General Chairman of the Reinforced Plastics Division, Society of the Plastics Industry, and several others from the press and from trade associations.

ACR Notes

Printed on behalf of the Administrative Committee on Research

Beginning with the April, 1954, issue, a column known as "ACR Notes" has appeared regularly in the *ASTM BULLETIN*. While there has been no strong indication as to the acceptance of this column by readers of the *ASTM BULLETIN*, it has nevertheless been decided to continue it for several more issues. Several modifications are planned and as a preview of what is to come we might point out the following items.

Beginning possibly with the May issue, each member of the Administrative Committee on Research will prepare the material to be used in an issue of "ACR Notes." This will undoubtedly lend variation to the column and will probably be slanted along more specific fields.

Although there will not be a separate news account concerning the recent meeting of the ACR held in Columbus on November 15 some brief notes of the activities of this group seem in order.

One thing under consideration is the sponsoring of a session or symposium at the annual meetings dealing with research currently under way in various fields. Four or five papers from different fields would certainly attract a broad segment of the Society membership and plans are tentatively being made for holding the first of these sessions in 1956.

A new feature which the committee hopes to encourage in the *ASTM BULLETIN* is a series of "popular" articles, perhaps 1000 words in length and dealing with the work of a particular committee. Such a series of articles will serve several purposes—not only to publicize the work of the Society but also to give credit to the work and progress of our many technical committees.

A similar recommendation will be referred to the Board of Directors suggesting that technical committees of the Society include in their annual report a special "research section." This will not necessarily be a detailed report of the research work but will be a brief summary or may merely list the items under consideration.

The committee feels that reader interest in articles on other research organizations such as the National Research Council which appeared in the February, 1954, *BULLETIN* warrants continuation of this series and such items will appear periodically.

There was discussion at the meeting of the "Review of ASTM Research" which appeared as a separate reprint in May of 1953 when it was agreed to revamp a previous edition and include many items which were pertinent to earlier review. It was agreed that future revisions should be spaced at shorter intervals and that each succeeding review should include research active only since the immediately preceding issue. Subsequent reviews would make reference of course to the May, 1953, pamphlet and periodically more comprehensive reviews would be issued.

As indicated in the December 1954 *BULLETIN*, a revised and enlarged edition of "Some Unsolved Problems" is now available from ASTM Headquarters. This new edition was sent to about 2500 schools and industrial and commercial laboratories engaged in research studies. A number of replies have been received and some of the more pertinent ones will be abstracted and published in future issues of this column.

Anyone desiring a copy of the revised edition of "Some Unsolved Problems" (August, 1954) should write ASTM Administrative Committee on Research, 1916 Race St., Philadelphia, 3, Pa. Copies may be obtained without charge.

National Reactor Testing Station of the AEC

"The Crown Jewel of Materials Testing" One of Five Atomic Installations in Idaho

As the area of knowledge in the physical sciences grows, so does the application of those sciences by the ASTM in revealing the properties of materials. Within the last decade, the science of nucleonics has grown more and more important, and increasingly the new science is being brought to bear by the society both in increasing the knowledge of materials and as a new means for testing their properties.

The Materials Testing Reactor provides a new and powerful means for applying a new kind of stress to engineering materials, and it is the materials engineer who will measure the stresses and evaluate their effects.

LOCATED on approximately 700 square miles of sagebrush plain in southeastern Idaho is the National Reactor Testing Station of the United States Atomic Energy Commission. In this area are five technical installations, including the Materials Testing Reactor (MTR) operated by the Phillips Petroleum Co., the Experimental Breeder Reactor (EBR) operated by Argonne National Laboratory, the Submarine Thermal Reactor (STR) operated by the Westinghouse Electric Corp., a Chemical Processing Plant (CPP) operated by Phillips Petroleum Co., and ground testing facilities of the Aircraft Nuclear Propulsion (ANP) Project, to be operated by the General Electric Co.

The Materials Testing Reactor (MTR) could well be considered the crown jewel of materials testing in the world today. The MTR develops the most intense flux of neutron radiation of any known reactor and is used extensively by the AEC for various types of irradiations, especially those concerned with its reactor development program. The MTR is also used to produce radioactive isotopes of a level of radioactivity greater than can be produced in any other known reactor.

Recently provision was made for limited use of the reactor by industrial, medical, and educational organizations for work on projects not related to the Government's atomic energy program.

The MTR Policy Board of the Atomic Energy Commission establishes the priorities for irradiations in the reactor. The Phillips Petroleum Co., Atomic Energy Division, assigns members of its technical and engineering staff to work with the experimenter on the design and construction of his apparatus, its interlocks to the reactor safety system, and all other details to ensure safety to the reactor, the experiment, and personnel. Some 30 AEC

laboratories or contractors are conducting work at the MTR. About 100 irradiations are in progress.

While the reactor is now comfortably loaded with important Government work, there is occasionally unused space in the high-flux regions and there is often available space in lower-flux regions. Such space has now been made available, on a limited basis, for irradiations for the public, as recently announced by the AEC. Because of security considerations, experiments for the public must be performed by Phillips Petroleum Co. Information as to feasibility and cost will be supplied by Phillips, while authorization to receive radioactive material must be had from the Isotopes Division of the Atomic Energy Commission, Oak Ridge.

Foremost purpose of the MTR is to test the effects of intense neutron radiation on materials and fuel elements to be used in future reactors which will operate at high fluxes and specific power, under simulated operating conditions of temperature, pressure, and particular coolant. Simultaneously the MTR is used in fundamental experiments in nuclear physics for which its high flux makes it unique, in the production of radioisotopes, and for many other purposes. The high intensity of flux—10 to 100 times that available elsewhere—reduces irradiation times proportionately and produces to a marked degree effects barely discernible in lesser neutron fields.

Construction Details

The MTR is a thermal (slow) neutron reactor using uranium enriched in isotope U-235 as fuel, ordinary water as both moderator and coolant, and beryllium as the reflector. It is designed to generate 30,000 kw of electricity. Both the fuel and reflector are enclosed in a 55-in. diameter aluminum tank which is extended by stainless

steel sections above and below to form a 30-ft deep "well," which is closed top and bottom with heavy lead-filled steel plugs.

The top plug is removable so that the fuel can be replenished and the beryllium in the reflector changed to accommodate experiments. The radioactive fuel elements and other pieces are lifted with grappling tools and lowered through a chute and valve mechanism in the bottom of the reactor tank into a canal holding 18 ft of water. The reactor tank is always kept filled with water for shielding as well as for cooling, and unloading operations are conducted by working through 20 ft of water.

Mounted on the top plug are the driving mechanisms for the rods controlling the reactor's rate of fission. The basic principle of control is to insert cadmium, a strong absorber of neutrons, close to fuel elements to stop the chain reaction, and to remove it just far enough to permit the chain reaction to proceed without multiplying out of control. As fuel is consumed, the cadmium is pulled farther out. In the MTR there is a fuel section below the cadmium part of the control rods, which thus is pulled into active status as the cadmium is removed: this prolongs the time the reactor will function between shutdowns. In case of emergency all control rods drop by gravity to bring their cadmium sections into the active fuel.

In order to provide additional space having thermal neutron fluxes above 10^{12} neutrons per sq cm per sec, a secondary reflector of graphite is placed outside the reactor tank. It is divided into two zones. The outer zone is a wall about 3 ft thick, built up of graphite blocks, enclosing the inner zone, a volume about 7 ft square and 9 ft high surrounding the aluminum tank. This inner zone is filled with some 700,000 graphite balls 1 in. in diameter. These can expand freely as they heat and can be replaced easily if damaged by the intense radiation close to the tank. Cooling air flows over the balls and through holes in the solid graphite.

Completely surrounding the graphite wall is a thermal shield, consisting of 4-in. thick layers of steel, which absorbs most of the heat flowing from the graphite and in which most of the residual energy of the radiation from the reactor is given up. A 4-in. space between the plates provides a passage for cooling air.

Finally, a concrete shield about 9 ft

thick reduces the radiation escaping to such a small value that people may work safely around the reactor. The outer dimensions of the structure form roughly a 32-ft cube. Barytes (barium sulfate) aggregate is used instead of conventional gravel because its greater density permits a thinner shield to be used. About 3000 tons of concrete went into the shield.

The reactor lattice and the beryllium reflector are cooled by water flowing at a rate of 20,000 gal per min. This water enters near the top of the "well" at 100 F and leaves near the bottom at 111 F. It is fed by gravity from a 170-ft high tank through the reactor tank to a vacuum spray evaporator system for cooling and degassing, and is then pumped back to the tank. The water for cooling is highly purified so that the minimum possible radioactivity is induced in it as it passes through the reactor. To further prevent the build-up of radioactivity in the cooling water a small amount is continuously removed to a retention basin where it is held until its radioactivity has decayed to the point where it is no longer a health hazard. It is then pumped to a leaching bed where it soaks into the soil. A secondary circulating stream of water from a cooling tower is used in the condensers of the spray evaporators.

The graphite reflector and thermal shield generate heat equivalent to about 500 kw by absorption of neutrons and gamma rays. They are cooled by air flowing at a rate of 25,000 cu ft per min. Large blowers in a fan house create a suction in the reactor structure so that the air is taken from the reactor building. It is discharged to the atmosphere through a 250-ft high stack. The air is filtered before passing through the reactor to remove particles which might become radioactive.

Experimental Facilities

The experimental facilities of the MTR are as varied and flexible as possible. Provision is made for bringing a neutron beam outside the reactor for use in a crystal spectrometer and a time-of-flight spectrometer ("neutron chopper"). Most of the experimental work, however, consists in irradiating materials in various positions inside the reactor as described in the following paragraphs.

Reflector Positions.—Several sections of the beryllium reflector inside the reactor tank are designed for easy replacement by special reflector pieces of beryllium or aluminum with the proper size holes to receive materials to be irradiated. The material under investigation is generally encased in

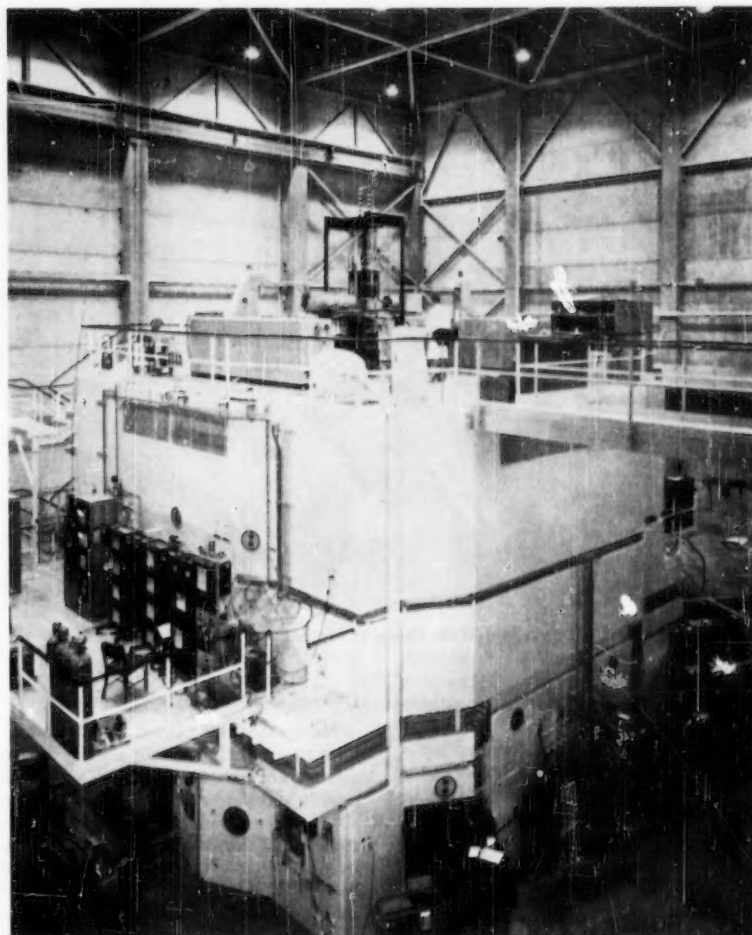


Fig. 1.—North and West Faces of Materials Testing Reactor.

aluminum cylinders or rings. Irradiation continues during the complete operating cycle of 2 or 3 weeks. In many cases it is possible to bring instrument leads and other connections outside the reactor through gasketed access holes adjacent to the top plug.

Beam Holes.—The main "beam" holes are mostly devoted to high priority AEC work. These are accessible at the outer face of the concrete shield and extend inward to the reactor lattice through "thimbles" projecting into the reactor tank, or in some cases only as far as the reactor tank wall. The inner ends of most of these holes are 6 in. in diameter. Since these holes penetrate to the highest flux in the reactor they are potentially hazardous from a radiation viewpoint and their use is correspondingly difficult and complicated. Each must be filled with a shielding plug during reactor operation.

The plugs can be removed only during shutdown of the reactor, and even then

residual radiation is such that special radiation doors in the beam holes must be closed. Since the portions of any plug inside the thermal shield become highly radioactive heavy lead-shielded casks are required for handling them.

In addition to the main experimental holes there are six more which run horizontally through the graphite wall. Four of these are for experimental work and two for reactor control instruments. They are either 4 or 8 in. in diameter.

Shuttle Tubes.—Shuttle tubes are pipes about 1 in. in diameter penetrating the reactor structure close to the lattice. By means of either air or water pressure, shuttles containing the experimental material can be driven to the region of high flux and retrieved even during reactor operation. Thus short-time irradiations may be made.

Vertical Experimental and Instrument Holes.—Much irradiation space at reduced neutron fluxes is available in holes accessible from the top of the reactor,

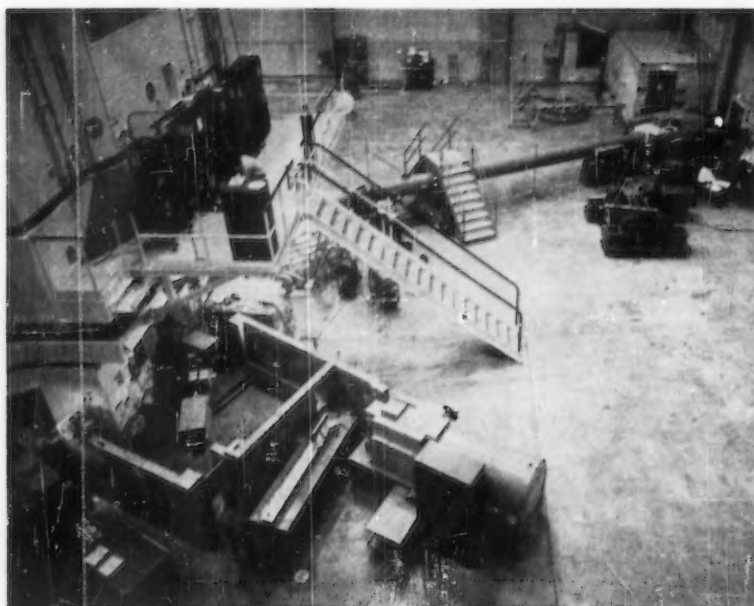


Fig. 2.—South and West Faces of Materials Testing Reactor.

Some of these penetrate into the pebble graphite and some into the permanent graphite; two are also accessible from a room under the reactor. The dimensions range generally from 2 to 4 in. in diameter. There is also space in four 6-in. thimbles which extend into the 30-in. cooling water pipes. In two of these are instruments for measuring the radioactivity of the exit water. A high-gamma, neutron free flux is available for experimental purposes in the other two.

Thermal Column.—A "thermal column," 6 ft square and 8 ft long, built up of graphite blocks, extends from the east face of the permanent graphite wall to provide a very pure thermal neutron flux. Several experimental holes penetrate it. Four inches of lead at the inner face cuts the gamma ray flux in the column and, with an additional 10 in. at the outer, reduces the radiation escaping from the reactor to a harmless level.

Gamma Ray Facility.—The fuel units on discharge from the reactor and before shipment to the chemical processing plant have to be stored under water in the canal for several weeks because of intense radioactivity and the thermal energy still remaining in them, both resulting from fission product decay. By stacking these units in a rectangular array, an intense field of essentially pure gamma radiation has been made available. This is probably the most intense field of gamma radiation available in the country. Radiation doses of the order of 10^6 to 10^7 roentgens per hour are available.

Gamma Ray Heating

Most materials placed in the reactor tank or graphite reflector are subject to considerable heating from the gamma rays which arise from fission, fission product decay, and neutron captures in structural material. The values go from 5 w per g to 0.10 w per g in the beryllium reflector, but with the water cooling there available this heat can be handled for almost any material being irradiated. In the graphite, the gamma heating is significantly lower than in the tank, but since only air cooling is provided, heat removal must be analyzed carefully. Superimposed on this gamma heating due to the reactor is any fission or capture heat developed by the material being irradiated.

Service Facilities

The reactor building is 130 by 131 by 80 ft high. The top of the reactor structure is 24 ft above the floor of the building. There is 40 ft of clear space on all sides of the structure. A 30-ton crane having access to most of the floor area is provided. Filtered air is supplied to the building under slight positive pressure to prevent entry of dusty outside air.

Around the face of the reactor structure are outlets for electricity, gas, water, steam, air, etc., to service the various experiments. Spotted at intervals along the walls of the building are additional service facility outlets. "Warm" drains are available at several spots near the structure. These drain to a catch tank under the basement and

are pumped to control tanks outside the building. Here the liquids can be tested and pumped to larger permanent underground storage tanks or to the retention basin for later disposal.

A wing 128 by 141 ft provides laboratories and shops for the experimental program. The laboratories are equipped with standard services and a small special hood-vent system to handle small quantities of "hot" off-gases. Two will become stations for direct delivery of pneumatic shuttles from the reactor. Two Berkeley-type dry boxes and junior caves are available. There is also an all-purpose counting room, whose equipment includes a scintillation counter, a high-pressure gamma ionization chamber, and various flow type counters.

In a separate reactor service building of 100 by 160 ft, experiments to be inserted in the beam holes are completely set up and tested before bringing them to the reactor building.

In another building is a large hot cave for examining materials in air. This is similar to the caves developed by Argonne National Lab. and in use at several installations in the country. It will handle materials which have of the order of 10,000 curies of 1.5 to 3.0 mev gamma activity. Three windows are located in the north face of the cave and a smaller one on the west face. A pair of Argonne Master-slave manipulators and one General Mills Manipulator are installed.

Figures 1 and 2 are photographs of the Materials Testing Reactor. In Fig. 1 can be seen the bridge leading from the reactor top to the control room. Experimental equipment and recorders are on the balcony. In Fig. 2, on the other balcony, are more recording panels for experimental apparatus. The neutron tunnel of the neutron "chopper" is shown extending from the back corner of the reactor in Fig. 2. At the fore corner can be seen the crystal neutron spectrometer with its shielding.

Brick and Tile Research Center

The brick and tile industry will build a national research center to house its development efforts. The Structural Clay Products Research Foundation, has voted to construct the research center in the Chicago area to serve as general offices of the structural Clay Products Research Foundation to house most of the research projects being conducted. A site is being sought in the western suburbs of the city.

What Standards Mean to Us

General Comments and Background¹

By Robert J. Painter

To provide different viewpoints on the significance of standards and specifications and materials testing, the Chicago General Committee on Arrangements for the ASTM Fifty-Seventh Annual Meeting asked certain leaders in industry and Government to present the statements which appear below. Even though ASTM standards are widely used it is not only considered desirable but important that from time to time the Society review some of the broad aspects of standardization activities. In these papers a producer and a consumer of materials give their viewpoints following the general introduction by the ASTM Executive Secretary, and the importance of materials standards to the Department of Defense and how the Military is carrying out a standardization program forms the basis of the final discussion.

Reprints of these papers are being made available without charge and will be furnished in reasonable quantity.

AT THE outset it should be stated that we cannot hope to cover in this one relatively condensed session the many facets of this question (in this, I am sure the other participants agree). Other phases of this broad subject may be covered at succeeding meetings. Why are we having this discussion? One obvious answer is that with twenty years intervening² since the last ASTM discussion on the significance of specifications it is high time that we should be appraising once again what is taking place in the development of standards. For this we are greatly indebted to our Chicago committee for having urged the holding of a program such as this. We should more frequently attempt to evaluate the work on standards. We have, however, been so extremely busy doing the work with no one questioning its value that there has been little opportunity to appraise the work publicly. Certainly by their devotion to this work the judgment of many thousands of our leading technical men cannot be wrong. In ASTM alone there are about 6000 materials experts devoting intensive efforts to standardization and research.

The widespread distribution of the standards and other facts support the assertion that standardization continues on the march. I have no misgivings about continued progress. The quality and caliber of personnel making up an organization or a movement in large measure influence its direction and rate of progress. We are con-

fident that for this reason alone, we shall, ten years from now, see much more progress made.

Your other speakers will dwell on the significance and philosophy of specifications from their individual viewpoints.

Our Subject

What is the subject of our discussion? Presumably, we shall be using the words standards and specifications and testing methods somewhat interchangeably today. Someone has defined a specification as "a detailed statement of particulars." I am fond of Mr. Bancker's statement which he used in the Symposium on the Economic Significance of Specifications held jointly by ASTM and the Western Society of Engineers in this city just 23 years ago. He said, "Material specifications are simply definitions of the properties which the purchaser desires. In them are his best efforts to state in measurable terms properties necessary for satisfactory use. They include test methods, cover the disposition of material which doesn't meet requirements, and provide an agreed-upon basis of inspection." That is the kind of specification that we are talking about today.

May I stress that a specification is valueless without adequate methods of evaluating properties of the material or product covered.

Incidentally, please note that there is reference to "disposition of material which doesn't meet requirements." That is a point sometimes overlooked in drafting a specification. Certainly the industry cannot simply discard a material that doesn't quite meet the rigid properties demanded in "Grade

A." Therefore, it is good economy to have a Grade B or C which this particular batch or heat would meet fully.

Trends

It was felt we should have some reference at least to trends in standardization work. Certain directions seem unmistakable. One is the closer co-operation we have seen in the last decade—compared with twenty or thirty years ago—between the consumer and producer. Each realizes that the other must grow and prosper. This is perhaps in contrast to the old days where I understand some meetings would break up after much heated discussion, although sometimes one solution was to go around the corner to the nearest saloon and cool off feelings with a soothing glass of beer (some of us may have a different viewpoint on whether this was constructive.)

However, in this connection there is one thing that troubles some of us, and that is a seemingly gradual falling off of active participation on the part of the consumer. We sense that with so many different materials to cover he may feel his efforts are too diluted to be of consequence. This is not so. And while the producers, at least in ASTM, who serve on our committees are very willing to do much of the spade work and draft tentative conclusions, they realize that the users of materials must continue to take an active part in all phases of this work.

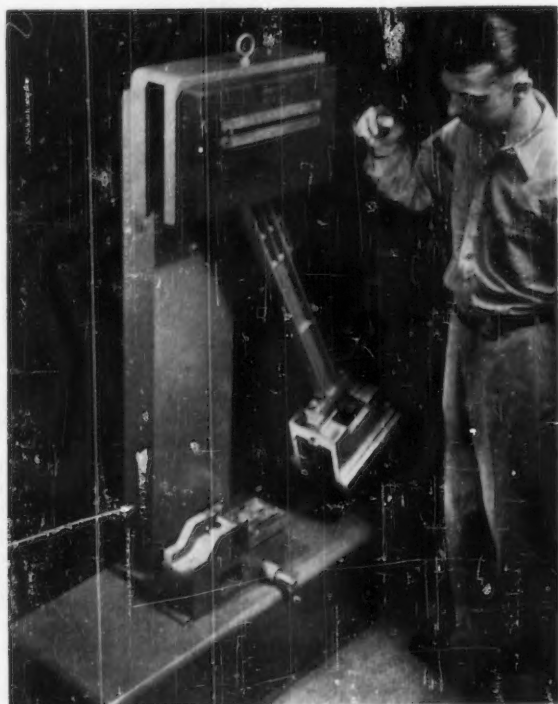
Also let us not forget that the producer of steel is a consumer of refractories and coal, that the large chemical manufacturer must procure huge tonnages of piping and fittings and equipment. In short, we need constantly to remind the large producer that he



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¹ This and the following three papers were presented at the Fifty-Seventh Annual Meeting of the Society in Chicago, Ill., June 13, 1954. J. J. Kanter, Crane Co., chairman of the Chicago Technical Program Committee, presided as chairman of the session.

² *Proceedings, Am. Soc. Testing Mats.*, Vol. 31, Part 2, p. 963 (1931).



ASTM impact tests reveal how material will conform under dynamic loading.

also is a large consumer. Many do accept this responsibility. It is in the interest of all of us that we continue to stimulate the active participation of the consumer.

Concerning the actual specifications, another trend is apparent in several fields, and that is to embody special requirements as supplements to the main document. This means that the consumer who wishes extra inspection, special tests, anything which it is agreed is not part of the basic requirements can invoke these by agreement. This practice seems to have worked out quite satisfactorily, for example, for steel forgings and various other steel products.

We have had some interesting experiences, perhaps they might be called cycles, in attempting first to consolidate in one document requirements for a broad range of products, such as steel castings; then as experience has shown this to be unworkable, covering a specific product with an individual specification. That seems to be a trend in many fields and while we perhaps should deprecate a large number of standards, industry—both producer and consumer—apparently finds it most efficient to have a concise statement with respect to the particular product rather than to go to a voluminous document and select the particular grade or sections which apply.

Whether it be a trend or not, there is another problem which concerns some of us. This has to do with the experience of men preparing standards. How can a technical or quasi-technical man hope to prepare an adequate specification unless he has background and experience in the product being covered? Our plea here is that he be permitted to participate in activities that will acquaint him better with the producer's facilities or the consumer's needs. If a standard specification is the goal and that is what we are talking about here, he must have some knowledge of the thinking of others. It is difficult to see just how sitting constantly at a desk can provide the background and viewpoint necessary.

Research

Strange as it might seem in a discussion of standardization, research must come into the picture. Today more realize than did ten or twenty years ago how important it is to have the best knowledge of materials. It is imperative that our standards be based on the latest and best knowledge of a material, to quote the first ASTM President, Charles B. Dudley.

Government Participation

We feel it essential that Federal and State Governments continue to take

a most active part in the development of specifications. With their huge purchases both for civilian and defense purposes they must continue to have a strong voice in developing standards. We feel that provision should be made for adequate personnel to take part in work, for example, that is going on in our technical committees. No amount of writing or correspondence can take the place of technical discussions in meetings. We in industry may need to assist toward this end. One of the easiest things for a short-sighted administrator to do is to lop off travel funds.

Standardizing Standards

There is no question that requirements for materials which are satisfactory to the consumer and which the producer can turn out in sufficient volume to bring him a reasonable return, must be based on recognized standards. The designer, who constantly embodies a few extra provisions or the Government official who feels that some particular situation warrants special properties or tests should be able to justify these strongly. In many instances these extras are unnecessary. Savings of millions of dollars would result if the specialties could be eliminated. Furthermore, as one good friend in Government said to me, "Bob, if we could just impress on our specification boys that while in peacetime industry may be willing to turn out materials or products with certain special requirements, come a shooting war with its requirements for huge quantities, the producer must concentrate on the standard items. There's no time for special features."

Standards and Recessions

No doubt many of you have been impressed as I have been with a significant and succinct report issued by the Committee for Economic Development on the subject, "What to Do About Recessions." Perhaps that is an ugly word, but the particular statement on national policy by the CED provides, I think, a pertinent closure for me. Actually in the recommendations, CED has not used the word "standard" once to my knowledge. This committee as you know includes a group of over 150 of our top business leaders who for some ten years have been studying the workings of our economy to improve it. It is an entirely private group.

Well, what do they stress? For one thing, *exploiting the potentialities of research to develop new products and improve production methods. Businesses should*

be vigorous to improve marketing, keep the consumer well informed and efficiently served. As an additional item they stress the value of trade associations along research and educational lines in their own industries.

I wonder how many of us consider the important place of standards in research. A few years ago we had a series of short articles by some of our leading members and later one or two small exhibits stressing its importance. It was an area to which little thought had been given despite the essential need for standard test methods in evaluating the results of research. Obviously a service test is the best method of evaluation, but long before, the development engineer must have some tools to determine tentatively at least how good his product is.

And what better way could there be to keep the consumer well informed than to use a recognized standard of quality?

With specific reference to the CED report on improving production methods, let me cite the report of a large machinery and chemical company on one of the most serious problems industry faces, namely,

"... determining an equitable formula to assure a steady rise in purchasing power

for labor, a high level of volume with resultant full-scale employment and, at the same time, the retention of reasonable profits for stockholders. The only way this mutually desirable goal can be achieved is by demonstrated increased productivity on the part of labor and by the continuous adaptation of cost-saving methods and equipment."

I submit that an important key, perhaps not the keystone but an important segment of the arch of increased productivity, is the further use of sound standard specifications and test methods.

Management's Position

Even though upwards of 20 per cent of our membership is in the top management brackets, I would not presume to speak for them. Certainly management today should be complimented on its support of standardization work. We feel strongly in ASTM that management sees the essential need for the type of work we are doing and no doubt maintains that same attitude toward other standardization activities.

We have wondered whether our top executives have or should have a knowledge of the standardization mechanics. Perhaps not, in view of the heavy administrative loads they must carry.

We do not see any lessening of management's support for the technical men on whom eventually must rest the responsibility for implementing this work.

If we are to avoid recessions and insure an expanded economy, which means an increased productivity, then standards work must continue. In ASTM we bespeak the continued co-operation of management and the technical fraternity who must achieve this.

Conclusion

Where has our standardization brought us? In ASTM alone there has been a manifold increase; for example, in 1931 when we were discussing the significance of specifications ASTM had 612 standards on its books. Ten years earlier there had been less than 300. Today we have over 2000 and the number increases every month. I am certain that every informed technical man and executive would not sell short the contribution which all of this work has made in advancing our economy. You will now hear from men who by training and experience are qualified to give some support to this statement and to provide interesting allied information.

Specifications from the Consumer Viewpoint

By A. W. F. Green

I AM reminded that back in 1917 a very nasty problem arose concerning the effects of arsenic in steels and I had recourse to various libraries and information sources; but, strange as it may seem, the most fundamental record and history of arsenic in steel or other ferrous metals was found in the library of the American Philosophical Society, founded by Benjamin Franklin in Philadelphia. However, philosopher or not, it is my problem to discuss what the consumer does about specifications.

My contacts with specifications for many different materials have extended over a considerable period of time, during which I have had to approach the problems involved from the producers' as well as from the consumers' standpoints. It is difficult to know which phase has been the most interesting, but I believe that experience in the production field, which preceded that in the consumer field, has served to temper the approach to many prob-

lems, especially during the past 20 years on the consumers' side.

My initial contact with material specifications concerned one governing the production of rifle and machine gun barrels and started in 1916. The significant point learned during that period, which came to embrace World War I, was that there were certain procedures or standards for the conduct of tests which were acceptable both to our governmental agencies and to industry as a whole. Notable were the contributions from ASTM.

I believe that the necessity for development of specifications, governmental or otherwise, whether for building bridges, ordnance, automobiles, aircraft, or roads stems from three main points: (1) engineering requirements for end-point results; (2) sufficient confinement of manufacturing processing to provide reproducibility of desired end-points, properties, and requirements; and (3) guidance for procurement.

Fundamental Materials Knowledge

The accomplishment of such requisites involves, first, a sufficient amount of data and knowledge to sustain the manufacturing processes that will insure meeting of at least minimum engineering requirements for the end-point application (providing for controls of composition, manufacturing methods, and processing details as well as quality control, and involving the



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use of standard procedures for the conduct of tests to determine the specified properties limitations); and second, methods for specification of either the raw materials or finished products or both. It is becoming a frequent complaint that too often specification-writing groups or individuals are dictatorial and attempt to act beyond their particular jurisdiction when devising specifications for materials or parts. They not only define the composition, but they proceed to outline the manufacturing processing; they dictate processing controls and finally detail the specific end-point physical properties, sometimes over a wide range of application. It is not uncommon for material specifications to call for specific test procedures.

Process Controls

It is difficult at times for the producer to accept process controls or procedures in material specifications. However, it does seem that acceptability of such controls is dependent upon the fundamental engineering requirements of the material in question. There are instances, for example, in the case of high-temperature alloys, when the temperature to which the materials should be heated before quenching in air or water for proper solution condition along with subsequent aging temperature becomes quite important and may be almost wholly dependent upon the prefabricational processing. Unless there is

complete knowledge of these process requirements and their limitations, it is possible that materials could be supplied to meet composition requirements by a wide-open form of materials specification and yet not accomplish even the minimum end-point requirements.

Processing may also involve many procedures, such as heat treatments, plating, welding, surface protection, marking, and shot peening, just to name a few. It may be of interest to know, for example, that the marking of parts, particularly in aviation work, is a most critical item. Any of us who have had anything to do with toolsteels learned long ago that the attempts to write a history onto a part by stamping or other means, then subsequently hardening it, frequently resulted in a broken piece. In aviation work, where many parts must carry a high load and are subjected to very high operational stresses, with very low margins of so-called factors of safety, anything that serves to concentrate stress is hazardous. Therefore, process control for marking is so important that it has become necessary to write clauses in some of the material or procurement specifications governing it.

Testing Requirements

Methods of testing for the evaluation and determination of properties of any specified materials must be carefully chosen. Composition, for example, can be determined by several means—

chemical, spectrographic, X-ray diffraction, just to name a few. Procedures of test of mechanical and physical properties may not be haphazard.

It was interesting recently to discuss some of our present-day ASTM standard methods of tension testing, particularly from the view of speed of testing, not only at room temperature, but also at elevated temperatures. It was found that there are many laboratories in this country that are not yet equipped with the most modern tension equipment, but have the older beam-type machines, and use the scribe method for yield point determination, whereas many specifications for materials require the use of the offset method for determination of such properties. Thus, procedures for testing and specifications calling for them must take cognizance of such factors. Incidentally, the question of control of speed of testing for tensile properties determination deserves attention from many of us.

The attempt to write methods of testing into specifications, as far as I am concerned, must be a major consideration between both the producer and the consumer. Evaluation methods should not be arrived at arbitrarily and consideration must be given to recognized standard procedures whenever they are available.

The work done by the various committees in ASTM at this time and in prior years provided the fundamental understanding for development of methods of test. The materials development programs, particularly since 1949, have necessitated constant additions to and study of test methods. It matters not whether you talk about wood or manufactured wood products, plastics, rubber and rubber-like products, steel, oil, gasoline, cement, or concrete, to name a few—all of them are involved.

Quality Control

During the past twelve to fifteen years the question of quality control has come forward in no small way, and it has become part and parcel of many of the specifications concerning terms and material usage and procurement. We have become quite familiar with magnetic particle testing, and we have also become familiar with other methods that reveal surface defects. We have made great strides in sonic testing for both solid and hollow bodies. It has become necessary to write some quality control procedures into material specifications. Here again, ASTM, in its various committees is doing constructive work in providing procedure methods and control evaluations, partic-



A key property in many materials is hardness. Here this property of rubber is being measured in accordance with an ASTM Standard.

ularly in the fields of non-destructive testing. Hardness testing procedures—the most modern micro-method, Rockwell, Brinell, Vickers, or even the file test,—are fairly standardized and recognized.

Consumers have a good reason for making specifications, but they cannot make specifications without the basic knowledge that I have referred to. None of the specification procedures that we attempt to use, regardless of source of conceptions—Government, industry, or otherwise—can work without first a fundamental and basic knowledge of the materials or processes involved.

Producer-Consumer Cooperation

Let me stress again that successful specification procedures involve producer cooperation and correlation with

the engineering requirements dictating the end-point usage.

It must be understood at all times that both consumer and producer have equal status in material evaluation. Recognition of this fundamental, in my belief, has made ASTM strong. I barged into the meetings of ASTM starting in 1917, and for a number of years I have been a member of the Society. It has been my privilege to work on some of the committees—plastics, rubber, steel, and also some others. This has been an educational venture as far as I am concerned and one that never ceases to involve me in more and more intricate work because none of us can give anything of ourselves to a project that we believe in without working for that project. Those of us who can and who have contributed in any small way to the work of this

Society cannot relax our efforts to keep our standards modern and future looking.

I stress this word "future looking." I have on my desk at home a little sign that frequently stands me in great stead. I am involved every day in specifications and interpretations and procedures and also in the evolving of new specifications. I work with research in our own corporation and with others. I work in development programs; things which we do not know too much about today but which must be covered in order to get some start and some producer's cooperation and consideration. This little sign reads:

God give me the patience to accept that which cannot be changed; give me the courage to change that which can and should be changed; and, above all, give me the wisdom to know which is which.

A Producer Looks at Standards

By A. O. Schaefer

A POLL of the business world and of the man in the street would probably indicate that they consider the subject of standards to be a pretty dull business. While almost all of us believe in standards, just as we believe in the Boy Scout movement or the dangers of excessive weight, if asked for examples of standardization we could probably not go beyond screw threads, nuts and bolts, or photographic film sizes.

The question of standards, if fully understood, could divide the Nation perhaps more definitely than the Republicans and Democrats. Few people believe in them as a principle that must be carried to its ultimate development; but some do. They are the purists who advocate standardizing all articles of commerce to the end that manufacturers can forget one element of competition and concentrate on factors such as manufacturing efficiency.

Opposed to the purists are those who believe standards to be the most subtle forms of regimentation. It is their view that standards stifle progress, that to do away with them would permit unfettered and free competition.

Most of us stand somewhere between these extremes, judging standards by our own values, feeling a real need for some but objecting to those that pinch or bind us here and there. This dual approach is shared by both producers and consumers because most of us often play a dual rôle—producing one thing

and consuming another. We are predisposed to applaud in theory the work of those engaged in promoting standards, but often become alert and suspicious when standards are being written covering the things we need.

Standardization is really a large subject. It involves philosophy, ethics, engineering, economics, and political science. It is obvious that we must have some standards. Our very language and our ability to understand each other is based on standard meanings for words, etc. Years ago we arrived at standards of measurement, and all buying and selling is based on such standards. Within the last fifty years, we have witnessed the setting up of many scientific standards for various articles of commerce. It is this last type of standard that we wish to deal with in this paper.

Any difference of opinion that may exist among producers on the subject of standards has to do with the question of how far we should go in the matter. Many products are made to recognized standards, such as rolled products of the "standard" steels, nuts, bolts, screws, nails, and washers, a lot of our pipe fittings, and many other items everyone can mention. It is recognized that there is a great saving in time and money for both producer and consumer in having such items standardized. Producers then know what they have to make; they do not have to spend as

much money for advertising such products; they can effect economies in their production because they do not have to make countless variations in these products to suit the whims of individual customers.

There is a value to the producer, and also to the national economy, in some less obvious areas of standardization. At the outset of the last war there were three or four principal manufacturers of steam turbines and electric generators in this country. The forgings required for these machines were at the time purchased to individual company specifications which had points of similarity but which differed in many other respects. A heat of steel cast to make a forging for one company, was usually not of a chemical composition suitable for another. Consequently unused portions of heats were carried in



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stock, yields from heats were poor, and consumption of critical alloys was wasteful.

Because of a bottleneck in Navy procurement, a conference was called very early in the conflict for the benefit of all consumers and producers of such products. The group was given the task of setting up common standards for all turbine and generator forging so that steel melted for one consumer could be used for another, and conservation of critical materials could be considered on a broad and intelligent basis. This remains in my mind as one of the Herculean tasks of our age. It was necessary to compromise thinking, preference, and prejudice of producers and consumers alike. It meant pooling much hard-won information. It involved a lot of plain hard work.

The results of those labors were published first by ASTM as a pamphlet printed on the pink paper characteristic of the emergency specifications. At the close of the war there was a serious question whether or not to continue the specifications in peacetime economy. It was done, however, and all of the specifications, so written, are now in the ASTM Book of Standards as standards. No one is proposing to remove them. They are discussed and modified year by year.

This is an excellent example of standardization that is of great help to both consumer and producer. Everyone who took part in the original discussion and in the subsequent ones has learned much about the product. From these discussions have come improvements. The standards exist as a bulwark against whims and fancies on one hand, and against lack of progress on the other. The annual discussions on these standards reveal to the producer what is required of him, which way he should go, what research and development he should underwrite.

As an example of how discussion on standards leads to research, a recent experience in this same group may be cited. In thrashing out the propriety of aging tension test specimens from large forgings, the question of hydrogen content of the steel was introduced. Now a task force is leading a research on the importance of hydrogen in steel forgings and what recognition of it should be taken in specifications.

There are fields where most producers hope to avoid the setting up of standards—where needed improvement brings about constant change—products which are sold by brand names such as tool steels, motor oils, paints, and many others. In these fields competition among producers takes the form of continuous research and investigation

aimed at obtaining a competitive advantage by improving the product.

In areas such as these there is little doubt that the premature arrival at standards would take much if not all of the drive from the effort to improve the product. Why try to make a better mouse trap if all the mouse traps in the world are required to meet a static standard which cannot anticipate all of the possible avenues of progress?

But there are other kinds of standards which are invaluable to the producer even for products such as those we just mentioned. These are the standards for testing procedures. A producer may believe he makes the hardest tool steel in the world. What good is this to him if a competitor features hardness, too, and demonstrates it in an entirely different way. Competition becomes chaos when we do not have uniform yardsticks to use to measure our products.

The tool steel producer needs standard methods of chemical analysis, standard means of measuring hardness, standard cutting tests, if he is to be able to present his product effectively to the consumer.

The paint manufacturer needs standard methods of testing the wearing qualities of his paints, if he is not to waste his time in unscientific discussions. Standardization of methods of testing have long been part of the ASTM program. The need for workable standards in the field of testing has promoted much valuable research.

Even when new tests appear on the horizon, there is need for specifications setting forth the essential areas of agreement between producer and consumer. A famous example of this type of standard is found under the title of Methods of Magnetic Particle Testing and Inspection of Heavy Steel Forgings (A 275)¹ in the ASTM Book of Standards. When this standard was first prepared, magnetic particle testing was in a very confused state. The method was revealing all sorts of conditions, real or imaginary. Every test was preceded and followed by long periods of argument. It might have appeared that the time was not ripe for the establishment of a standard.

The standard that was issued in the midst of these conditions is an excellent example of the value of such work. The committee that drafted it included producers and consumers. Opinions as to the value of this or that method, or the interpretation of this or that result, were all discarded. The committee searched only for those factors on which producer and consumer had

to agree if they were to hope to reach agreement over the results. The method is still changing and the standard test method and the acceptance criteria to go with it in this field are yet to come but the ASTM Method is now used almost universally with a minimum of difficulty because it has staked out very definitely the essential areas of agreement.

The formulation of standards of this type has also pointed the way to much research and development work. Development of exposure tests for paint, as well as atmospheric corrosion tests for metals have provided fertile fields in this respect. The difficulties of comparison of tests conducted by individual laboratories led to research into the causes of such variation. We now know how absolutely necessary it is to duplicate conditions in the most minute detail. Altitude above sea level, all angles, backing, and many other factors must be considered. An amazing amount of research has gone into these fields because of the necessity for standards, and the consequent need for information on which to base those standards.

In the complex expression of the philosophy of standards as seen by a producer, some comment has been made on the harm in bad standards, or in static standards. No progressive producer wants such standards, nor does anyone else.

Perhaps the greatest safeguard we have against this menace lies in the establishment of machinery for the preparation of standards that will give full voice to both the producing and the consuming group, and which will also allow other interested parties to contribute if they wish. It is natural that a specification drawn up by one interest, producing or consuming, should express the bias of its authors. It is only natural that such a group should resist changes in their specifications. Experience has indicated that the best guarantee of progress in specification writing is to put the responsibility for it in the hands of a producer, consumer, and general interest group. In such a group, new developments are reported quickly. One segment might be content to let them go for awhile, but that group that feels it would be most benefited by change will soon introduce action, and force consideration of the development. This is typical of the functioning of ASTM.

Of equal importance in keeping up-to-date standards is the provision for making changes and alterations. My own subcommittee in ASTM (Subcommittee VI on Steel Forgings of Committee A-1 on Steel) meets twice

¹ 1952 Book of ASTM Standards, Part 1, p. 723.

every year. At every meeting the membership is called upon to suggest any change they consider desirable. The history of our work indicates that over a number of years we have made some changes every year. Certainly we do not have static standards under this kind of condition.

It must be admitted that all producers do not share the same enthusiasm for standards. There are groups that have consistently resisted all efforts to prepare specifications in their fields. It must be admitted that the need for standards may or may not be established in such fields. If there is such a need, however, we can rest assured that it will be filled. Whether it will be good will depend on the constitution of the group that writes the standard.

An organization such as ASTM should vigorously investigate any such field of endeavor so that any specification writing will be put into the hands of a proper standardizing body such as ASTM.

Before closing any discussion of this

subject I should like to take a brief look at Government specifications and standards. The Armed Services have for years issued their own standards—certainly in the steel field with which I am familiar. The claim has been made in the past that the Armed Services had special needs which warranted specifications written exclusively for those needs. There can be little argument with this.

The only question left in the producer's mind is whether or not the Armed Services have not only covered their special needs with their own specifications but have also set up their own specifications for many items for which recognized standards exist which could be used to the mutual advantage of Government and industry. There is every indication that the use of standards is receiving full consideration in Government circles today. Certainly all standards-writing bodies recognize the valuable contribution that representatives of Government can make to their deliberations.

The producer's position on standards if it can be generalized, is something like this—and here I am taking the liberty of trying to express their composite viewpoint, as it has been expressed to me by a number of my associates and in published articles on the subject. Let us have good standards for standard articles prepared by truly representative bodies with continuing authority to review their work frequently so that progress and change will be provided for. Let us not attempt to write standards for those products which are not standardized. Here we should allow progress and development full sway. In all fields let us have an active standards body that will continuously review conditions and set up standards for the testing and appraisal of the product. In brief, let us try to realize the advantages of standards in their proper place, and intelligently avoid the promotion and use of poor standards or of standards for products which are not yet fully developed.

Material Standards and the Department of Defense

By Captain C. R. Watts, USN

THE standardization program of the Department of Defense necessarily covers a considerably broader field than standardization as it is known to the American Society for Testing Materials. ASTM standards deal primarily with uniform methods of testing and uniform specification requirements for raw and basic materials, plus certain fabricated items. Standardization, as it is known within the Department of Defense, includes the development of uniform specification requirements for all items of common use to the Army, the Navy, and the Air Force. The field includes not only the basic materials but components, equipment, processes, and services. In addition to this type of standardization, the program includes the standardization of engineering practices and procedures essential to design, procurement, production, inspection, and application of items of military supply.

Defense Standardization Program

Many people think of the standardization program as it is related to Public Law 436, 82nd Congress, which became effective July 1, 1952. As many of you who have been members of ASTM technical committees know, standard-

ization within the military departments is not new. Over a period of many years the military departments have worked closely with the ASTM committees in the development of specifications and standards for testing, as well as with respect to engineering practices. In specific fields of engineering endeavor many of these programs date back to the early days of the century.

Military standardization was given added impetus in 1942 by the establishment of the Joint Army-Navy Specifications Board. The objectives were to establish a joint Army-Navy series of specifications to be used for items or materials similar in technical requirements and peculiar to the War and Navy Departments. This joint board was later superseded by the Munitions Board Standards Agency, which, in turn, became the Office of Standardization under the Defense Supply Management Agency and, at the present time, the Standardization Division of the Office of the Assistant Secretary of Defense (Supply and Logistics).

While in the past standardization efforts have proceeded as purely voluntary coordination between the military and other elements having areas of mutual interest, Public Law

436 makes mandatory the achievement of the highest practicable degree of standardization of items used throughout the Department of Defense, through the development and use of single specifications, in the elimination of overlapping and duplication of item specifications and in the reduction of the numbers of sizes, kinds, or types of generally similar items. It further requires the greatest practicable degree of standardization of methods of packing, packaging, and preservation of such items, together with the most efficient use of services and facilities concerned with the inspection, testing, and acceptance of such items.



C. R. WATTS, Staff Director for Standardization, Office of Assistant Secretary of Defense, Washington, D. C.

Specifications and Standards Defined

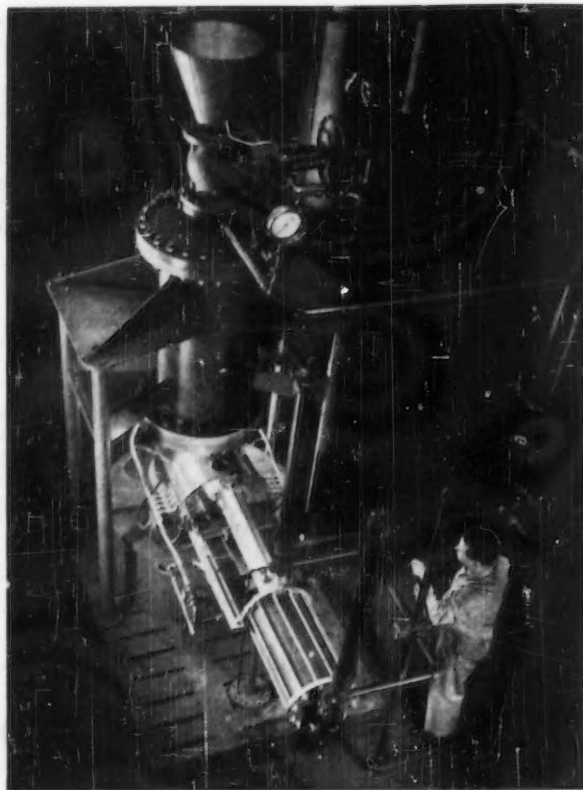
In contrast to the language used by most of the technical societies in which no positive distinction is made between what constitutes a standard and what constitutes a specification, it has been found necessary for us to make that distinction. Therefore, we have defined standards as documents that establish engineering and technical limitations and applications for items, materials, processes, methods, designs, and engineering practices. Specifications are defined as purchase documents that contain clear, accurate descriptions of the technical requirements for items, materials, or services, including the procedures by which it will be determined that the requirements have been met. Specifications for items and materials shall also contain packaging requirements.

While Public Law 436 relates specifically to items of supply, the defense standardization program necessarily covers a much broader field. In addition to standardization efforts looking to the reduction in the variety of component parts needed to support these items, considerable effort is being spent in the development of basic engineering standards which will have the effect of promoting standardization and interchangeability in the design of new items. Such engineering standards as limits and fits, dimensioning and tolerancing, preferred numbers and many others are receiving considerable study by the Department of Defense. Close working relationships have been established with the several technical societies primarily interested in these fields.

By items of supply we refer to items which are purchased in quantity and carried in stock for future use. Actually there are many specifications for end items or equipment which are not purchased in quantity and carried in stock. It is just as important for us to attain the maximum degree of standardization in such end items and equipment in order to reach our objectives—improvement of the efficiency and effectiveness of logistic support to our fighting forces and conservation of money, manpower, time, production facilities, and natural resources. The standardization of items of equipment and machinery, such as internal combustion engines, pumps, generators, and electronic equipment, with the objective of reducing the number of different parts used therein, can prove to be one of our most effective means of improving logistic operations.

Coordination of Existing Specifications

Many specifications have existed within the individual military services, prepared by them for their own use. It



Simulated service testing is a field covered by ASTM Standards. Here a performance test is carried out on a steel valve.

has been possible therefore for the Army, the Navy, and the Air Force, as well as other agencies of the Government, to have prepared separate specifications for essentially similar items with very minor variations. It is the basic concept of the program that these specifications will be coordinated into a single specification to provide for identical items for the use of all services. This will prove a great advantage to industry, as well as to the Government, since uniform production requirements, inspection procedures, packaging requirements, and testing procedures will result therefrom.

It is axiomatic that effective logistic support of military operations in this country is primarily dependent upon the productive capacity of private industry. The Department of Defense therefore, in its standardization work, must be ever alert to guard against the development of requirements which will cause undue strain on these productive resources. Requirements necessitating major retooling by important segments of industry or requirements which are not feasible of achievement except through major upheavals in established economic relationships must be avoided, so long as the Department of Defense

secures the advantage of the latest technological developments. It is therefore established policy within the Department of Defense that specifications and standards shall be coordinated before adoption with a representative cross-section of the appropriate segment of industry.

Thus, while it is agreed that the motivation for standardization within the Department of Defense is that of a consumer, the standardization program cannot be carried on in isolation from the practical requirements of private industry.

Government versus Private Procurement

Another consideration necessary to an understanding of the Defense standardization program lies in the basic differences in procurement methods between private industry and the Federal Government. In private industry there is no legal requirement that prevents a company or an individual from buying directly from a single source. In contrast to this procedure, Government agencies are legally bound to advertise their requirements, obtain bids from qualified producers, evaluate those bids, and make award to the lowest bidder who proposes to furnish material in

accordance with the specifications. In these circumstances, equity to all potential suppliers requires that the specifications for the material being procured be precisely stated so that true competition may be had. This emphasizes the importance of specifications to Government agencies and to the producers who seek to supply them.

Generally speaking, commercial or industry standards, by which I mean standards and specifications promulgated by the technical societies, provide that the buyer shall specify those requirements not covered by the specification, such as the degree of testing or inspection desired and the method of preparing for shipment, packaging, and packing. It is further the sole responsibility of the consumer to determine the specification under which he desires to procure the material; and, provided he can locate a supplier who will meet his requirements, he may use such portion of any specification that he desires, or he may prepare his own.

This circumstance leads to a further distinction between Government and industry specifications. Military and Federal specifications are mandatory for use by Government agencies, and deviations therefrom are authorized only after full justification has been furnished. Further, Government specifications contain complete requirements for the inspection and testing of materials, specific requirements for packing, packaging and, in some cases, the method of shipment. These requirements protect the Government's interest and provide a uniform basis for competitive bidding.

Use of Established Standards

In order to eliminate repetitious publication of testing methods and other well-established standards, there has been published a considerable number of documents which then are referenced in the specification. Among these may be mentioned Federal specification VV-L-791 which covers the methods of inspection, sampling, and testing of lubricants, liquid fuels, and related products. It is interesting to note that some 60 per cent of the methods described in this document are identical with ASTM standards. In these cases the ASTM standard is referenced directly as being identical. There are, of course, many other instances of the direct application of ASTM and other technical society standards to military requirements.

The Coordination Program

It may be of interest to describe in somewhat greater detail the nature of

the program which is being developed. As I have previously stated, one of the initial objectives has been to consolidate existing specifications which have been in use by the military departments. This responsibility is assigned to a preparing activity, which may be one of the bureaus of the Navy Department, a service of the Army, or a command of the Air Force. It becomes the responsibility of that activity to obtain the concurrences of the other departments in the coordinated specification eventually developed. In the event that the other departments have no interest in the item, the specification is issued as a limited coordinated specification by the department concerned.

This program is proceeding on a time schedule with a target date for completion by July 1, 1955. In connection with this coordination program and with the Federal Cataloging Program, which is an across-the-board determination of all items carried in stock by all departments, a review of the number of common-use items of any given kind is being made with the purpose of determining what limitations should be placed upon the future procurement of such items. When it is recognized that a Federal specification provides for the furnishing of material to all departments and agencies of the Government, it becomes obvious that any one department may require only a limited portion of the area covered by a single specification. We are then in conjunction with the three military departments, determining those limitations of kinds, sizes, types, and numbers of items which we will, in the future, procure. This action should further prove advantageous to manufacturers, in that orders for relatively smaller quantities of a wide variety of items will be replaced by orders for larger quantities of a smaller variety, resulting in economy to both the producer and the Government. An example of such standardization which is actively in progress but has not yet been completed is that of anti-friction bearings.

In addition to the development of a single series of specifications, the defense standardization program is presently being evolved along lines which will require that all groups and classes of commodities carried in the supply systems of the military departments be specifically analyzed for the purpose of identifying areas in which reductions in the sizes, kinds, and types of items may be made, not only of the end items themselves, but of the spare parts which are carried in stock for the repair and maintenance of these items. Reduction in the variety of items has many obvious advantages. It will provide economies

in storage and other supply operations, and, by virtue of increased quantities which will be procured, should lead to economies in production and cost to the Government.

One of the most serious problems with which we have been confronted over a long period of years is the problem of maintenance and logistic support of mechanical, electrical, and electronic equipment installed as components in ships, tanks, aircraft, and other major applications. Such items have in general been procured on the basis of performance specifications or purchase descriptions, frequently by the prime contractor for the ship, airplane, or vehicles concerned. There has then resulted a wide variety of manufactured equipment requiring support by enormous quantities of repair parts. We are engaged in investigating the potentialities of standardization with respect to equipment or machinery of this nature.

Industry's Part

I need not point out that this becomes an extremely complicated program. The potentialities for improvement of logistic support of operating forces are enormous as well as the potentialities for monetary savings. It is a field in which we have made some progress. It is also a field in which we can get nowhere without the full cooperation of the industries concerned. Studies of this nature have been undertaken by task groups of technically qualified personnel from the using departments. These task groups must initially arrive at some determination of the method and degree of standardization which will be attained. Industry advisory committees are established at an early date in the program in order that their knowledge and experience will be available and the extent to which standardization is feasible may be determined. Once a program has been established, it has been our experience that the industry groups, through the establishment of working units, are the people who actually accomplish the desired result.

The scope and complexity of this standardization effort are so great that a definitive reorientation of the principles, objectives, and criteria of the defense standardization program is being developed at the present time in order to provide direction to this effort. A basic document setting forth the philosophy and basic principles underlying the defense standardization program has been developed and is presently being coordinated with the military departments. It is quite likely that, before this document is signed by

the Secretary of Defense, I will want to review its basic features with the officers of ASTM as well as other outstanding technical and professional societies throughout the country. This will give me some assurance that the point of departure for standardization within the Department of Defense contains no major provisions which will lead the Department of Defense and private standardization societies along diverging roads.¹

This is a matter of vital concern to the Department of Defense, as evidenced by the fact that one of the major provisions of this restatement of objectives is the development of a program for the adoption of commercially recognized standards to the maximum feasible extent. This policy is consistent with the thought previously expressed that great dependence for the support of our fighting forces is placed on the productive capacity of our economy. Nothing makes greater sense, therefore, than that the requirements of the Department of Defense should be stated in terms that are meaningful to private industry, and if reference to an existing commercial standard is meaningful to

¹ EDITOR'S NOTE.—This Directive was issued on October 15, 1954, by Defense Secretary Charles E. Wilson. It is designated under 4120.3 and is entitled "Defense Standardization Program." Before issuance many comments from the main Government departments and from technical groups were included.

President L. C. BEARD, JR.—Mr. Chairman, this is one of the most constructive meetings it has been my pleasure to attend. I think the speakers are to be complimented on the paper they have presented. They have explored not only the obvious aspects of standardization but they have even taken the opportunity to discuss some of the more controversial aspects.

For example, there is the matter of brand selling of standardized articles. I recall not so long ago the chairman of the board of one of our large industries saying that when industry ceases to serve the public it will no longer prevail and I would like to add that unless they adequately serve government, which is the public, they will not long prevail. In these troubled times industry is going to have one awful job remaining independent and not becoming regimented via socialistic ideologies.

The comments made today have indicated how industry can more adequately serve the public and that this

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11,250,000 cu ft of concrete were poured into the building of Grand Coulee Dam on the Columbia River. A very significant part of ASTM work is concerned with specifications and tests for concrete.

private industry, that is the way, in my opinion, that the military requirements should be stated. It should be necessary to depart from these standards only to the degree that they do not give full recognition to the military requirements.

When the size and complexity of the standardization program within the Department of Defense are contemplated, I am much impressed with the magnitude of the job we are laying out for ourselves. I am convinced that enormous benefits in terms of improved

logistic operations and savings in the performance of logistic operations are possible. Much understanding and cooperation within the Department of Defense and within industry as well are an essential to the successful prosecution of this program. I am confident that the Department of Defense can look to the American Society for Testing Materials and other professional societies throughout the country to lend support and encouragement to this standardization effort. We shall need all of the help we can get.

DISCUSSION

will indeed serve a most useful purpose.

Mr. R. C. ADAMS.²—I should like to add particular emphasis to two points which have recurred in the remarks of several of the speakers. One is the advantage of consumer participation in standardization; the other is standardization and regimentation.

Departments of the Federal Government, as mentioned by Captain Watts, must procure all supplies by open purchase under published specifications. This places us under considerable pressure to standardize, to define our needs in standard specifications. In our efforts of this sort we have found our Society association as consumer members of technical committees to be particularly valuable. If this is valuable to us as nonproducers, should it not be equally valuable to producers in the areas where they are consumers? But this opportunity is overlooked by many. In addition to his natural interest in ASTM Committee A-1 on Steel, a steelmaker should be active as a con-

sumer of lubricants in Committee D-2 on Petroleum Products and Lubricants. And the oil refiner, instead of limiting his ASTM effort to Committee D-2, should be concerned about the quantities of thermal insulation he buys under the standards of Committee C-16 on Thermal Insulating Materials.

Standards can be a means of regimentation, if they are framed closely about existing processes and compositions. A more vital type of standard, avoiding this adherence to the here and now without looking to future developments, is the performance standard. By this approach producer and consumer agree upon what a product shall do and how that performance shall be determined, rather than mutually accepting as adequate an available process or product. This frees the manufacturer to employ his ingenuity and superior production skill to provide end products of continually greater worth. A trend toward performance standards has appeared in recent years, and we who have been ardent proponents of the idea hope it will find increasing acceptance in the councils of the Society.

² Chemical Engineering Superintendent, U. S. Naval Engineering Experiment Station, Annapolis, Md.

The Precision of Fuel Rating, 1947 to 1953

By Richard M. Gooding and Robetta B. Cleaton

The ASTM, through its Committee D-2 on Petroleum Products and Lubricants, has long been intimately associated with the efforts of the petroleum, automotive, and aviation industries in working out standard methods for evaluating the anti-knock quality of various hydrocarbon fuels. In the early thirties, the American Petroleum Institute and the Society of Automotive Engineers, through the jointly sponsored Coordinating Research Council (CRC), set up an arrangement for cooperative studies of fuel ratings with participation of a number of interested laboratories. The Coordinating Research Council was organized in 1922 by the SAE and the API as a means of effecting cooperative effort of these industries in solving problems of mutual interest.

This paper is one of a continuing series of progress reports published from time to time in the BULLETIN, the previous one having been in 1949 (1).¹

THE year 1953 marked the 20th year of monthly cooperative testing of motor gasolines to determine the knock characteristics (octane numbers) of these fuels and to determine the precision of the test methods used. Diesel fuels have been cooperatively tested for 15 years and aviation fuels have been tested similarly since 1940. The early exchange tests were started by a voluntary group of refiners, engine builders, and service organizations. In 1934 the Cooperative Fuel Research Steering Committee (later the Coordinating Fuel Research Committee of the Coordinating Research Council) asked the National Bureau of Standards to analyze the results of tests on the cooperative exchange samples and on the fuels used in the CFR 1934 Uniontown road tests. At the request of CFR, the National Bureau of Standards accepted management of the motor fuel exchange and later added management of the diesel and aviation exchanges, at the same time continuing to analyze all the exchange test data. H. K. Cummings was the early Leader of the Exchange Group.

In 1947, control and further development of the five test methods were transferred to ASTM, and Research Division I on Combustion Character-

istics (DCC) was organized in ASTM Committee D-2 on Petroleum Products and Lubricants under the chairmanship of Donald B. Brooks. The Exchange Group, with Donald B. Brooks as Leader, became a part of the DCC organization and was called the ASTM-DCC National Exchange Group. The National Bureau of Standards continued to compile, analyze, and report the monthly exchange tests until July 1, 1950 when the ASTM entered into a cooperative agreement with the Bureau of Mines, Department of the Interior, to handle the work. R. M. Gooding became the new chairman of the Exchange Group.

Previous analyses of the precision of fuel ratings have been published, the last publication covering the 5-yr period 1942-1946 (1).¹ This paper, covering the 7-yr period 1947-1953, represents an analysis of 19,570 engine ratings of 294 fuel samples by the five test methods, as reported by member laboratories and by nonmember participants in the three semiannual exchange tests.



R. M. GOODING, Petroleum Chemist, Bureau of Mines, has been chairman of the ASTM-DCC National Exchange Group since 1950.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

¹ The boldface numbers in parentheses refer to the list of references appended to this paper.

² Standard Method of Test for Knock Characteristics of Motor Fuels by the Research Method, (D 908-53), 1953 Supplement to Book of ASTM Standards, Part 5, p. 213.

³ Standard Method of Test for Knock Characteristics of Motor Fuels by the Motor Method, (D 357-53), 1953 Supplement to Book of ASTM Standards, Part 5, p. 201.

Standard Methods of Fuel Tests:

Motor fuels are rated by the Research (D 908)² and Motor (D 357)³ Methods (2). By both methods the engines are operated at the fuel-air ratio giving maximum knock, and a standard knock intensity is obtained by varying the compression ratio. Until 1948 both methods employed a bouncing pin and knockmeter to measure knock. In 1948 after extensive tests, the Phillips Detonation Meter was approved as alternate standard equipment for the bouncing pin. Operator preference for the Detonation Meter led to the gradual abandonment of the bouncing pin by many laboratories and its final elimination from the methods on January 1, 1954. By the Research Method, the engine is operated at 600 rpm with a carburetor intake air temperature of 125 F. By the Motor Method, the engine is operated at 900 rpm with an intake air temperature of 120 F. As it is essential in the Motor Method to maintain a constant mixture temperature to obtain precise results, a mixture heater assembly is employed to control the temperature at 300 F. The two test method engine conditions differ in other respects. In rating fuels by the two methods, some fuels rate materially higher by the Research Method; such fuels are termed "sensitive." This fuel sensitivity is defined as the research octane number minus the motor octane number.

Aviation fuels are rated by the Aviation (D 614)⁴ and Supercharge (D 909)⁵

⁴ Tentative Method of Test for Knock Characteristics of Aviation Fuels by the Aviation Method (D 614-49 T), 1952 Book of ASTM Standards, Part 5, p. 669.

⁵ Tentative Method of Test for Knock Characteristics of Aviation Fuels by the Supercharge Method (D 909-49 T), 1952 Book of ASTM Standards, Part 5, p. 679.



R. B. CLEATON, Statistical Assistant, has been associated with the National Exchange Group since 1936, transferring to the Bureau of Mines from the National Bureau of Standards in 1950.

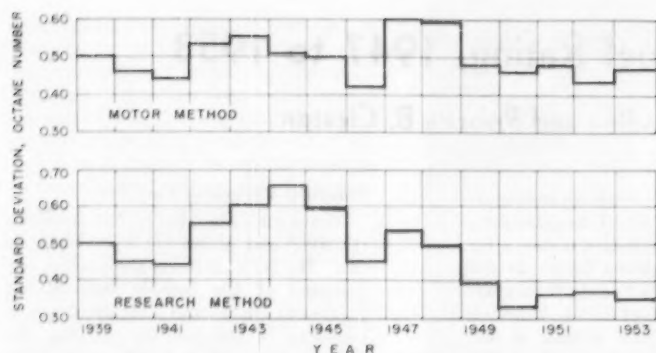


Fig. 1.—Precision of Rating Motor Fuels, 1939–1953.

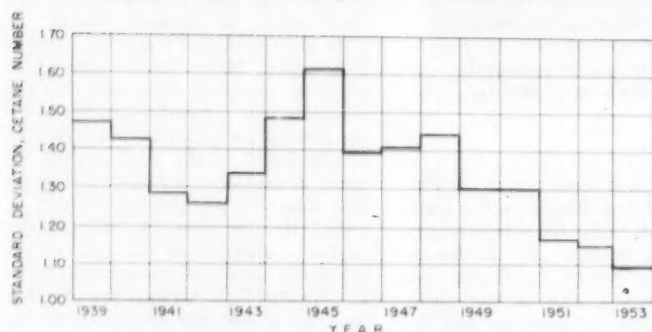


Fig. 2.—Precision of Rating Diesel Fuels, 1939–1953.

Methods (2). In the Aviation Method, the reading of a thermal plug flush with the combustion-chamber surface is used as an index of knock intensity. The compression ratio is varied to give a thermal-plug reading defined by a "match temperature" line, which is obtained empirically.

In the Supercharge Method, knock intensity is judged by ear. Observations of power output at a standard "trace" knock are made at a series of fuel-air ratios from lean (about 0.08) to rich (about 0.12). The engine is operated at a fixed compression ratio of 7 to 1. The supercharge pressure is varied to give standard knock intensity for each fuel-air ratio used. A typical rating curve, superimposed on a portion of the supercharge reference fuel framework, is shown in Fig. 4. The supercharge rich rating (D 909)⁶ is calculated by interpolation at the peak of the lower reference fuel curve, point A. A rating is also made at a fuel-air ratio of 0.095, point B, which is close to the take-off mixture strength in full-scale engines.

Diesel fuels are rated by the Cetane Method (D 613)⁶ (2). A combustion indicator is employed, and the compression ratio is varied to give a standard ignition delay with the test fuel.

The primary reference fuels used for the Research, Motor, Aviation, and

Supercharge Methods are normal heptane (*n*-heptane) and isooctane (2,2,4-trimethylpentane), and tetraethyllead in isooctane. Ratings of aviation fuels are commonly expressed in performance number. The primary reference fuels for the Cetane Method are normal cetane (*n*-cetane) and alpha methyl-naphthalene.

Precision:

The precision, sometimes termed reproducibility or repeatability, of these fuel ratings has long been indicated in terms of a numerical expression called the standard deviation. The standard deviation, generally denoted by σ , is a measure of the tendency of experimentally determined values to scatter around their average. It is based on the deviation of values from the average of the values. Standard deviation can be expressed as:

$$\sigma = \sqrt{\frac{(X_1 - \bar{X})^2 + (X_2 - \bar{X})^2 + \dots + (X_n - \bar{X})^2}{n - 1}}$$

where X_1 is the first in a series of determined values, X_2 is the second, and X_n represents the last value. \bar{X} is the average numerical value for all the measurements, and n is the number of values in the series. The standard deviation also can be written in the equivalent form:

$$\sigma = \sqrt{\frac{X_1^2 + X_2^2 + \dots + X_n^2 - n\bar{X}^2}{n - 1}}$$

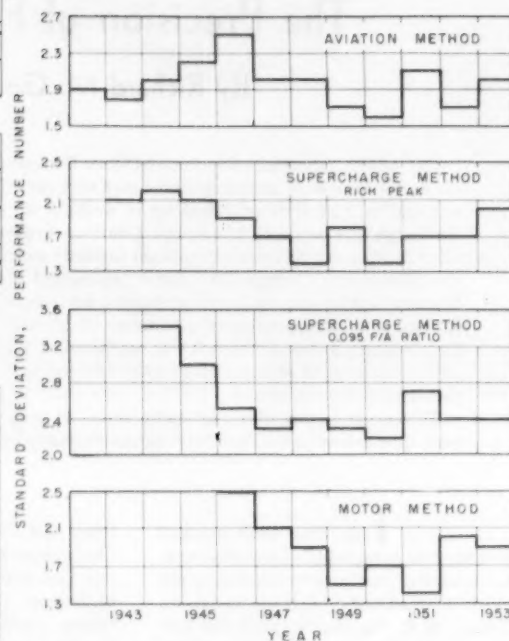


Fig. 3.—Precision of Rating Aviation Fuels, 1942–1953.

Many excellent books on statistical methods, including the ASTM Manual on Quality Control of Materials, discuss the standard deviation and its application to experimental work, and any one of these can be consulted by the interested reader not familiar with the term and its utility. If the determined values in a series of measurements deviate from the average in a normal manner, two thirds of these deviations will be numerically less than the standard deviation, about one value in twenty will be twice the standard deviation, and one in a hundred will be $2\frac{1}{2}$ times the standard deviation. Once determined, the standard deviation can be used to predict the accuracy of future tests provided the conditions that affect accuracy are not altered. It thus can be used to determine how many measurements are required to establish a value to a desired degree of reliability. Conversely, it can be used to determine how much above the minimum acceptable quality one or more test results must be to insure obtaining material of adequate quality.

The precision—expressed in terms of the standard deviation—of rating for all three fuel types by all five test methods is shown graphically in Figs. 1, 2, and 3. By the Motor Method, the precision for the past seven years is 0.50 octane number, the same as for the preceding 5-yr period 1942–1946. By the Research Method, the past 7-yr

⁶ Tentative Method of Test of Ignition Quality of Diesel Fuels by the Cetane Method (D 613-48 T), 1952 Book of ASTM Standards, Part 5, p. 688.

precision is 0.40 octane number, an increase in precision of 30 per cent over the 0.57 octane number precision for 1942-1946. The standard deviation for the Cetane Method of rating diesel fuels in this study is 1.27 cetane numbers, as compared to 1.42 cetane numbers for 1942-1946, an increase in precision of 11 per cent. An improvement in the rating of aviation fuels by the Aviation Method is shown by a standard deviation of 1.9 performance numbers for 1947 to 1953, compared to 2.1 performance numbers for 1942-1946. Supercharge-Method ratings of aviation fuels were compiled for the first time in 1943. For the present period, the average standard deviation is 1.7, a 19 per cent gain over the average of 2.1 performance numbers for 1943-1946. Beginning in 1944, data were also obtained on Supercharge-Method ratings of aviation fuels at a fuel-air ratio of 0.095. For the past seven years the average standard deviation is 2.4 performance numbers at this ratio. Ratings of aviation gasolines by the Motor Method have proved interesting, and such ratings have been obtained regularly by the Exchange Group since 1946. The precision of these ratings for 1947-1953 is 1.8 performance numbers.

The precision of rating for all fuels by the five test methods calculated for nonmember participants in the semi-annual exchange tests is not so good as that maintained by the Exchange Group members. For the five methods, member precision was an average 18.7 per cent better than nonmember precision, ranging from 10.0 to 32.4 per cent better.

Sample Supply and Distribution:

Each monthly exchange sample is rated on or before an official test date each month. For motor fuels, this test date is the second Tuesday of the month; for diesel fuels, it is the third Tuesday; and for aviation fuels, it is the fourth Tuesday. Results are reported to the Exchange Group Chairman at the Bureau of Mines on or before these test dates. These dates apply likewise to the semiannual tests, in which all owners of ASTM-CFR engines are invited to participate. The fuel test samples—1 gal for motor and diesel, 5 gal for aviation—are supplied by the industry members of the three Exchange Groups on an equitable basis. Two samples are distributed to all participants in the semiannual tests, so that member laboratories rate 14 samples each year in each group, and nonmember laboratories can rate 4 samples each year. Nonmember participants are charged a fixed fee to cover costs of sample supply, distribu-

tion, and part of the charges involved in compiling, analyzing and reporting the data. Exchange Group member laboratories pay a yearly fee to cover costs of the project.

MOTOR FUELS

Ratings of Exchange Samples:

The basic data obtained by the Exchange Group on motor fuel samples R-341 to R-438 covering the 7-yr period 1947 to 1953 are given in Table I. The column headed "Sensitivity" gives the difference between the Research and the Motor-Method ratings in octane numbers. The test results indicate no relation between the sensitivity of the motor fuel samples and standard deviation. The tetraethyllead content of each fuel is the average of the values reported by laboratories making this determination. The column headed "n" indicates the number of member laboratories reporting valid results, from which the averages and standard deviations are calculated. The "Range" column shows the numerical difference between the highest and lowest results reported.

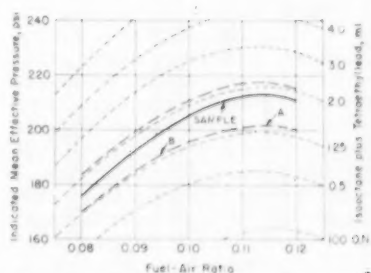


Fig. 4.—Typical Rating Curve by Supercharge Method.

There is no apparent correlation between precision of rating the samples and composition of these samples. Tetraethyllead content has no effect on the precision of rating by either method. Only five samples indicated lead contents as high as 3.0 ml. It is well known that motor tractor fuels with high distillation temperatures and low octane numbers are difficult to rate and give high standard deviations, regardless of composition. Plots of the standard deviations for each sample by both methods (Fig. 5) with octane number level indicate that the best precision by the Research Method occurs between 86 and 100 octane numbers, and by the Motor Method it occurs between 75 and 88 octane numbers. In both cases precision appears to decrease outside these limits, but closer examination of the data shows that these high standard deviations, particularly at low octane-number level, were obtained before 1950. Only two samples had research ratings above 100, and only three had motor ratings above 90 octane numbers.

Precision of Rating:

Figure 1 indicates rather clearly a stabilization of precision in rating motor fuels by both the Motor and Research Methods in the past five years; it also indicates that the 7-yr precision is adversely affected by high standard deviations in 1947 and 1948. The Research-Method chart shows a steady improvement in precision since a high standard deviation in 1944. For the past five years the average standard deviation by the Motor Method is 0.47 octane number, compared to 0.50 for 7 yr. Results for the Research Method show a 5-yr average of 0.36 and a 7-yr average of 0.40.

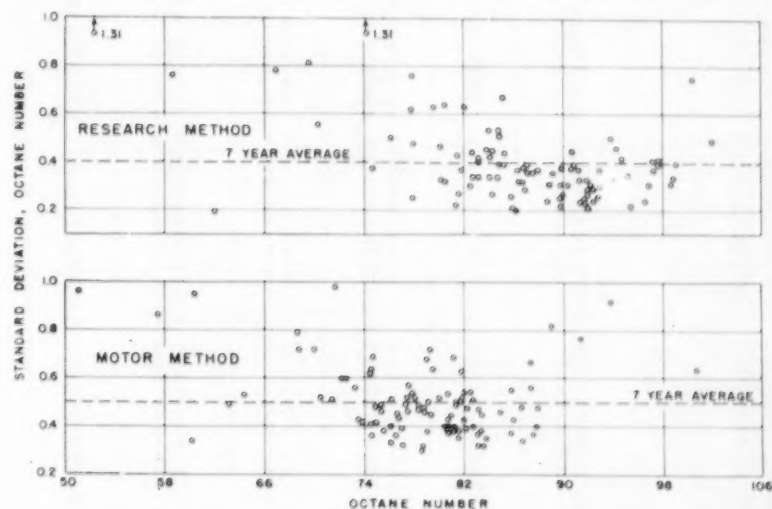


Fig. 5.—Precision of Motor Fuel Ratings versus Octane-Number Level.

TABLE I.—BASIC DATA ON MOTOR FUEL (R) SAMPLES IN OCTANE NUMBER.

Sample	Motor Method				Research Method				Sensitivity	Tetra-ethyllead, ml per gal
	Octane Number	n	Standard Deviation	Range	Octane Number	n	Standard Deviation	Range		
R-341	70.5	20	0.52	2.1	74.1	16	1.31	5.3	3.6	0.00
R-342	74.6	20	0.41	1.6	84.8	17	0.53	2.0	10.2	0.00
R-343	60.1	18	0.34	1.8	60.0	14	0.19	0.8	-0.1	0.00
R-344	81.7	19	0.50	1.7	92.0	15	0.27	0.8	10.3	0.00
R-345	81.2	20	0.68	2.3	94.7	15	0.42	1.2	13.5	0.00
R-346	51.1	19	0.96	3.8	52.3	16	1.31	4.3	1.2	0.00
R-347	93.8	20	0.92	3.3	96.5	19	0.24	1.0	2.7	1.50
R-348	68.7	20	0.72	3.0	70.3	17	0.56	2.0	1.6	0.52
R-349	79.0	21	0.68	4.0	91.3	19	0.37	1.2	12.3	0.46
R-350	77.3	17	0.49	1.8	84.4	16	0.39	1.8	7.1	0.00
R-351	79.3	21	0.72	2.6	84.9	19	0.51	2.1	5.6	1.64
R-352	74.6	18	0.36	1.2	78.0	18	0.48	2.1	3.4	2.96
R-353	78.4	19	0.48	2.1	84.3	19	0.45	2.0	5.9	1.75
R-354	73.3	19	0.56	2.3	76.1	17	0.50	1.5	2.8	1.03
R-355	74.6	19	0.64	2.2	82.7	15	0.34	1.1	7.1	0.00
R-356	76.2	20	0.51	1.8	84.3	17	0.27	1.0	8.1	2.45
R-357	79.1	22	0.50	2.6	86.2	18	0.37	1.2	7.1	2.43
R-358	80.7	24	0.49	1.6	84.7	21	0.34	1.4	4.0	0.00
R-359	57.4	23	0.86	3.3	58.6	17	0.76	2.9	1.2	0.00
R-360A	64.3	23	0.53	2.5	66.9	19	0.78	3.2	2.6	1.60
R-361A	77.6	23	0.57	2.8	81.5	20	0.43	1.6	11.3	0.00
R-362	77.9	23	0.54	1.9	89.2	17	0.36	1.5	9.3	0.00
R-363	68.6	20	0.79	3.2	71.9	17	0.76	2.7	12.2	1.60
R-364	76.7	22	0.45	1.6	82.7	18	0.44	1.7	5.9	1.85
R-365	77.8	22	0.45	1.6	85.1	18	0.67	2.7	6.7	0.00
R-366	78.4	22	0.49	2.2	83.8	20	0.45	1.8	8.7	0.00
R-367	74.5	24	0.62	2.7	80.4	22	0.64	3.0	8.7	0.74
R-368	71.7	24	0.98	4.3	80.4	22	0.64	3.0	10.0	0.17
R-369	80.7	26	0.43	1.7	90.7	28	0.38	1.3	9.6	0.00
R-370	75.6	27	0.38	1.7	85.2	26	0.39	1.7	8.2	0.92
R-371	71.4	28	0.41	1.9	79.6	29	0.63	2.5	5.9	0.06
R-372	76.6	30	0.36	1.3	82.5	30	0.30	1.0	3.3	0.00
R-373	81.8	26	0.63	2.7	95.1	28	0.35	1.5	11.9	2.89
R-374	78.8	27	0.48	2.2	90.7	24	0.45	1.5	10.1	1.12
R-375	78.9	26	0.46	1.8	87.1	27	0.39	1.4	7.4	2.06
R-376	81.9	26	0.52	2.4	92.0	22	0.29	1.0	5.1	0.00
R-377	74.7	25	0.69	3.3	80.1	24	0.63	2.3	8.8	1.86
R-378	75.0	24	0.42	1.6	80.1	25	0.47	1.9	9.9	2.83
R-379	77.1	26	0.32	1.3	77.9	24	0.25	0.9	7.4	0.00
R-380	79.5	23	0.64	2.2	93.8	25	0.50	1.9	9.8	0.00
R-381	78.7	27	0.32	1.1	86.2	25	0.20	0.9	7.5	1.24
R-382	81.6	27	0.38	1.5	91.4	25	0.24	0.9	6.2	0.00
R-383	80.7	24	0.39	1.5	86.9	23	0.29	1.0	4.7	2.01
R-384	70.0	24	0.72	3.5	74.7	25	0.38	1.8	6.6	0.00
R-385	81.0	24	0.40	1.9	87.6	25	0.36	1.1	9.3	0.00
R-386	80.7	25	0.40	1.7	90.0	25	0.27	1.2	10.4	0.00
R-387	74.9	23	0.48	1.8	85.3	24	0.44	1.5	5.7	2.33
R-388	81.6	20	0.35	1.3	90.9	21	0.39	1.8	9.3	1.21
R-389	76.1	20	0.40	1.5	81.8	21	0.37	1.7	9.9	2.06
R-390	82.3	21	0.48	1.5	83.2	22	0.34	1.2	5.7	1.24
R-391	77.5	22	0.52	1.9	92.4	21	0.24	0.9	10.4	1.60
R-392	82.0	21	0.43	2.0	91.3	23	0.33	1.1	8.8	1.86
R-393	82.5	22	0.54	2.5	97.2	22	0.37	1.3	9.9	1.62
R-394	87.3	22	0.56	1.2	86.0	22	0.21	1.7	9.4	0.00
R-395	78.6	22	0.30	1.7	83.2	21	0.40	1.4	5.3	1.81
R-396	73.8	22	0.42	2.7	77.8	21	0.62	2.2	6.2	3.01
R-397	72.5	23	0.60	2.1	89.9	24	0.38	1.5	10.3	0.61
R-398	80.0	23	0.52	1.1	92.9	23	0.37	1.5	11.3	0.00
R-399	80.7	22	0.34	2.3	91.8	21	0.23	1.1	9.4	2.54
R-400	81.5	23	0.50	1.9	99.2	20	0.40	1.9	10.9	0.00
R-401	87.9	19	0.48	0.8	92.2	20	0.31	1.2	3.0	1.96
R-402	82.8	19	0.40	1.2	87.1	19	0.36	1.4	10.5	0.00
R-403	76.2	19	0.33	2.7	95.7	21	0.40	1.6	9.2	1.83
R-404	100.7	18	0.64	1.5	88.0	22	0.37	1.6	7.2	1.98
R-405	77.5	21	0.46	2.0	91.9	21	0.33	1.0	4.6	0.62
R-406	82.7	20	0.51	3.8	96.2	24	0.46	1.7	6.7	1.50
R-407	89.0	20	0.82	1.7	81.6	21	0.27	1.1	8.6	2.96
R-408	77.0	20	0.39	1.6	85.8	20	0.26	0.9	9.6	3.07
R-409	79.1	20	0.38	1.2	91.8	22	0.31	1.1	8.3	0.68
R-410	83.2	19	0.32	1.6	84.1	22	0.42	2.0	5.9	0.46
R-411	85.8	18	0.37	1.6	95.4	18	0.22	0.8	11.1	0.39
R-412	84.6	18	0.48	1.8	96.9	21	0.31	1.1	11.1	3.03
R-413	77.1	18	0.39	1.3	90.4	21	0.31	1.5	6.8	0.33
R-414	73.6	19	0.43	1.8	80.5	21	0.32	1.3	7.8	0.00
R-415	75.4	17	0.49	1.7	81.3	18	0.22	0.7	9.1	0.82
R-416	80.8	20	0.54	1.8	89.9	22	0.26	1.0	9.0	2.93
R-417	83.4	20	0.38	1.5	84.0	22	0.53	2.0	4.8	0.66
R-418	75.4	20	0.46	1.7	80.2	22	0.33	1.3	10.5	2.23
R-419	83.4	16	0.45	2.0	93.9	23	0.34	1.3	8.7	0.39
R-420	78.1	18	0.52	1.5	86.8	21	0.32	1.1	11.1	0.00
R-421	87.8	17	0.40	1.4	98.9	20	0.34	1.4	6.5	2.66
R-422	79.1	16	0.38	1.4	86.9	19	0.38	1.2	6.0	0.00
R-423	63.1	17	0.49	1.5	69.6	20	0.81	3.0	8.2	2.56
R-424	81.2	18	0.39	1.6	84.1	22	0.41	1.4	3.4	0.33
R-425	91.4	19	0.77	2.8	102.0	21	0.40	2.0	2.9	0.01
R-426	85.0	20	0.46	1.8	91.7	22	0.25	0.8	10.6	3.86
R-427	79.4	20	0.45	1.6	86.5	22	0.32	1.6	6.7	2.55
R-428	72.4	18	0.60	2.2	83.2	20	0.42	1.8	7.1	0.65
R-429	87.3	19	0.67	2.4	100.4	21	0.75	3.0	10.8	0.00
R-430	83.1	18	0.37	1.5	92.9	22	0.40	1.3	13.1	2.96
R-431	87.5	18	0.37	1.6	98.6	21	0.31	1.3	9.8	0.00
R-432	83.2	21	0.47	1.9	88.7	23	0.24	0.7	5.5	2.66
R-433	86.0	20	0.43	1.5	97.2	23	0.41	1.9	6.0	0.00
R-434	83.8	20	0.35	1.3	92.0	22	0.21	0.7	8.2	2.56
R-435	82.0	18	0.54	1.6	89.9	19	0.22	1.1	7.9	2.00
R-436	80.7	20	0.38	1.4	84.1	24	0.34	1.4	3.4	1.53
R-437	83.5	17	0.32	1.1	92.8	23	0.26	1.0	9.3	1.23
R-438	85.8	18	0.55	2.1	97.7	23	0.41	1.4	11.9	3.00

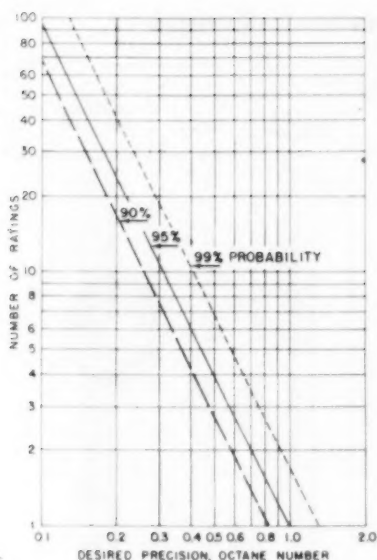


Fig. 6.—Number of Motor-Method Ratings Required to Yield an Average Having a Desired Precision.

The number of ratings found on each of the three lines gives the indicated probabilities that the average rating will be within the desired amount of the true value.

How to Use the Precision Measures:

From past experience and a study of the present 7-yr data, it can be concluded that the results obtained by both the Motor and Research Methods are normally distributed and that the calculated standard deviations are valid and can be used with assurance.

A standard deviation of half an octane unit or less means that about 20 out of the next 30 ratings made under similar conditions will differ from the true value by half an octane unit. One or two of the remainder will differ by a full unit, but the chance of any rating differing by 2 units is quite small.

The average of two or more ratings usually will be closer to the true value than a single value. Figures 6 and 7 show the number of ratings required to yield an average having a desired precision. The lines in Fig. 6 are based on a standard deviation of 0.50 octane number for the Motor Method, and those in Fig. 7 are based on a standard deviation of 0.40 for the Research Method. The number of ratings indicated by the lines in Figs. 6 and 7 give 90, 95, and 99 per cent probability that the average of the ratings is within the desired amount of the true value.

Figures 6 and 7 show the reliability of the Motor and Research-Method ratings. Suppose there are four ratings on an unknown fuel. How near the true

value is the average of the four ratings? The solid line in Fig. 6 indicates a 95 per cent probability that the average Motor Method rating is within 0.5 octane number of the true value. In other words, only once in 20 times will this average vary from the true value by more than 0.5 octane number. If the four ratings are determined by the Research Method, inspection of the solid line in Fig. 7 shows a 95 per cent probability that the average rating is within 0.4 octane number of the true value. The two 99 per cent probability lines for the two methods can be used to determine how many tests will have to be run to insure the correct answer 99 times out of 100. Figures 6 and 7 indicate quite well the gains that are attainable with an increase in precision of the test methods. To insure a 95 per cent probability of being within 0.4 octane number of the true value by the Motor Method, the results of six tests must be averaged. For the Research Method, an average of four tests will give the same assurance. Had the standard deviation for the Research Method been 0.30 octane number instead of 0.40, only two tests would have been required to insure a 95 per cent probability of being within 0.4 octane number of the true value.

The above observations concerning standard deviations and probabilities apply only to determinations of octane numbers on unknown or unfamiliar samples. It is well known that an engine operator will approach the true value of a sample if he has any knowledge indicating what that true value is (or is supposed to be) and that, in refinery control operations, octane number determinations are more precise when

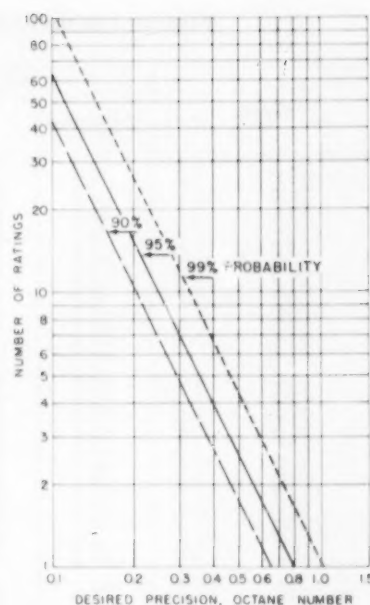


Fig. 7.—Number of Research-Method Ratings Required to Yield an Average Having a Desired Precision.

The number of ratings found on each of the three lines gives the indicated probabilities that the average rating will be within the desired amount of the true value.

operators run familiar samples from day to day.

Some interest has been expressed in an analysis of motor fuel ratings in terms of performance number. All motor fuel ratings by the Motor and Research Methods were converted to performance

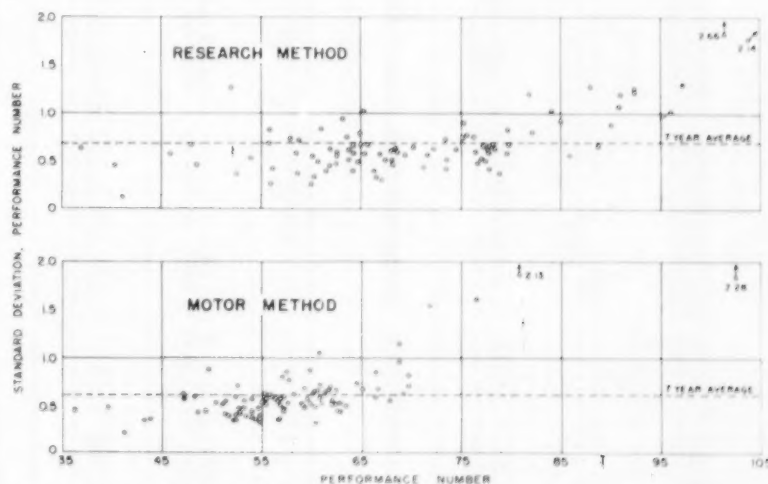


Fig. 8.—Precision of Rating Motor Fuels in Performance Number versus Performance-Number Level, 1947-1953.

TABLE II.—BASIC DATA ON AVIATION FUEL (A) SAMPLES IN PERFORMANCE NUMBER.
Supercharge Method.

Sample	Fuel-Air Ratio = 0.095				Rich Peak				Tetra- ethyllead, ml per gal
	Performance Number	n	Standard Deviation	Range	Performance Number	n	Standard Deviation	Range	
A-153	67.3	18	2.5	11.8	69.1	23	1.3	5.5	0.01
A-154	131.6	21	2.8	13.0	132.0	23	1.2	4.7	1.17
A-155	127.8	21	2.4	8.1	126.9	22	2.5	9.6	3.57
A-156	96.9	20	1.9	6.4	97.2	21	1.7	5.7	4.01
A-157	137.5	18	1.7	6.9	137.8	21	1.5	6.6	3.89
A-158	130.1	20	1.5	7.2	131.4	23	1.0	3.5	2.88
A-159	146.0	19	2.1	9.5	146.6	22	1.8	7.3	4.53
A-160	130.6	17	2.0	7.1	131.9	21	1.2	4.1	4.04
A-161	105.1	19	3.1	12.5	107.9	23	2.4	14.0	3.00
A-162	85.9	21	3.9	16.6	88.6	22	1.9	8.8	0.00
A-163	94.4	22	1.9	6.3	93.1	22	1.7	6.9	3.16
A-164	127.1	22	2.5	8.9	128.9	22	1.8	7.6	3.00
A-165	149.2	18	1.8	6.1	150.4	20	2.0	6.8	4.55
A-166	144.8	21	2.2	8.0	145.7	22	1.4	5.3	4.63
A-167	105.7	24	3.5	16.6	98.5	24	2.0	8.0	3.82
A-168	126.6	20	2.9	8.7	129.6	22	1.9	8.8	4.52
A-169	146.9	22	2.2	8.5	147.0	22	1.3	4.9	4.43
A-170	96.3	23	2.8	9.4	94.4	23	1.8	7.8	3.92
A-171	69.8	20	2.2	7.9	72.5	21	1.5	6.3	0.01
A-172	130.1	22	2.0	7.2	129.5	22	1.3	4.9	4.55
A-173	147.6	21	1.4	4.8	147.6	22	1.3	4.9	4.49
A-174	147.6	21	2.8	9.9	92.4	23	1.8	8.5	4.00
A-175	145.0	21	1.6	5.9	146.1	21	1.2	3.8	4.48
A-176	128.6	18	3.8	14.3	130.2	17	0.8	3.6	4.37
A-177	97.9	19	3.2	13.9	96.6	19	1.9	6.7	4.53
A-178	145.4	18	1.2	5.4	146.5	20	0.9	3.7	4.57
A-179	130.3	19	1.6	6.0	130.5	19	1.0	3.7	3.84
A-180	129.0	21	2.4	8.5	131.2	23	1.2	4.4	3.04
A-181	135.5	25	2.5	9.2	137.6	25	1.8	6.8	4.56
A-182	130.7	22	1.3	5.1	130.2	23	1.2	4.9	3.89
A-183	132.9	23	2.5	10.8	134.7	23	2.4	8.2	4.53
A-184	129.6	24	2.1	8.7	130.6	25	1.2	4.5	2.96
A-185	148.4	24	2.6	11.9	149.9	24	2.0	7.3	4.44
A-186	127.8	20	2.5	10.4	128.0	20	2.1	7.1	3.93
A-187	144.1	21	2.1	8.6	145.7	23	1.8	7.9	4.59
A-188	126.7	21	3.1	12.5	129.7	21	0.9	3.4	3.02
A-189	63.3	18	2.8	4.7	65.7	19	1.6	7.0	0.33
A-190	147.0	21	2.2	7.1	147.9	23	1.7	5.7	4.65
A-191	105.6	22	3.6	15.8	106.4	22	3.2	13.5	2.17
A-192	145.2	21	1.6	5.8	146.2	21	1.4	7.6	4.58
A-193	93.4	21	2.0	7.7	91.5	22	1.9	7.1	1.91
A-194	144.8	19	1.5	6.3	144.0	20	2.3	8.4	4.48
A-195	146.0	18	1.7	6.5	146.7	19	1.4	5.3	4.64
A-196	68.4	21	2.1	8.2	69.3	21	1.8	8.0	0.46
A-197	126.6	21	3.5	13.4	130.5	22	1.4	6.4	2.97
A-198	98.7	17	1.5	6.5	70.0	19	1.4	5.4	0.00
A-199	129.6	18	2.3	9.5	130.7	20	1.1	4.3	3.87
A-200	137.4	17	1.2	5.2	137.4	17	1.0	3.3	2.90
A-201	144.8	20	1.3	5.1	145.4	21	0.9	2.4	4.44
A-202	146.1	15	1.8	7.4	147.4	18	1.1	3.4	3.59
A-203	143.8	20	1.9	7.3	145.4	20	1.0	3.2	4.57
A-204	133.3	17	2.7	8.5	134.2	19	1.8	6.5	4.18
A-205	100.5	17	4.1	14.1	102.3	20	2.8	8.5	2.97
A-206	128.5	18	3.1	10.9	130.9	20	1.0	3.8	2.97
A-207	70.7	21	2.0	8.0	70.2	22	1.5	5.6	0.55
A-208	145.7	19	1.3	5.1	145.9	21	1.0	3.8	4.53
A-209	142.8	24	0.9	3.3	142.1	25	1.4	5.5	4.51
A-210	143.3	22	1.7	7.5	143.7	23	1.7	6.4	4.47
A-211	125.2	22	3.4	14.7	129.2	24	1.5	5.8	2.97
A-212	98.5	25	4.1	17.5	95.9	26	2.0	6.7	2.93
A-213	130.5	25	2.4	9.7	130.6	27	1.6	7.5	3.03
A-214	144.1	25	3.1	12.7	145.6	26	2.9	11.5	4.52
A-215	144.8	24	2.8	11.4	145.2	26	1.4	8.2	0.90
A-216	130.2	23	1.8	7.4	129.8	25	1.3	6.0	3.86
A-217	123.4	24	6.0	18.8	128.9	25	2.3	10.1	4.79
A-218	96.9	25	3.2	10.9	93.2	27	1.6	5.9	3.71
A-219	68.7	25	2.3	10.8	69.8	27	2.1	9.5	0.46
A-220	145.0	25	1.5	1.6	145.4	26	0.8	3.4	4.54
A-221	145.5	21	3.1	11.9	147.6	24	2.3	8.5	4.63
A-222	143.7	20	1.5	5.5	144.5	23	1.3	5.0	4.18
A-223	144.7	20	1.4	5.3	145.8	21	0.8	2.8	4.62
A-224	106.2	24	3.4	11.7	101.7	26	2.4	9.8	4.12
A-225	144.6	25	1.9	7.4	145.5	27	1.6	8.0	4.56
A-226	69.6	22	2.2	8.5	70.6	24	1.5	6.8	0.54
A-227	130.6	24	2.0	7.8	130.5	25	1.8	9.3	4.02
A-228	127.7	22	2.3	11.4	129.3	23	1.4	5.9	4.98
A-229	151.1	20	3.8	16.2	155.9	24	2.8	10.7	4.61
A-230	69.8	21	1.8	6.7	69.5	23	1.5	6.9	0.61
A-231	151.9	20	2.4	9.1	154.1	21	1.8	10.0	4.51
A-232	130.1	23	2.2	10.9	130.6	25	1.1	4.9	4.01
A-233	144.1	24	2.4	10.6	145.4	27	1.7	6.2	4.57
A-234	136.8	22	3.5	12.0	140.5	25	3.9	15.5	4.33
A-235	145.6	25	2.1	8.6	145.3	27	1.2	9.5	4.27
A-236	144.9	25	2.4	11.7	146.0	25	0.8	3.0	4.65
A-237	126.1	24	3.1	10.9	127.4	26	2.9	11.9	4.05
A-238	130.8	25	3.4	13.8	134.9	27	2.0	7.4	4.54
A-239	130.2	25	2.3	9.5	130.5	27	1.2	4.9	3.98
A-240	145.5	21	1.9	6.1	149.3	22	2.1	8.4	4.39
A-241	135.3	21	3.8	8.1	136.6	22	2.9	8.1	2.96
A-242	130.6	23	1.7	7.9	139.3	24	1.4	5.5	4.31
A-243	147.2	21	1.9	8.3	147.1	22	1.5	5.9	4.58
A-244	134.3	21	1.8	7.1	134.0	24	1.9	7.4	2.97
A-245	130.6	22	3.7	14.5	135.8	24	2.4	10.7	4.23
A-246	129.0	22	2.5	10.2	130.0	23	1.1	4.5	4.03
A-247	112.7	24	2.6	11.2	113.8	25	1.8	7.9	3.00
A-248	139.7	24	3.8	14.3	141.8	25	3.2	14.2	4.28
A-249	133.8	23	1.5	6.4	135.5	24	1.5	7.0	4.27
A-250	108.9	18	1.7	7.3	102.6	22	2.4	8.8	4.49

TABLE III.—BASIC DATA ON AVIATION FUEL (A) SAMPLES IN PERFORMANCE NUMBER.

Sample	Aviation Method				Motor Method				Tetra-ethyllead, ml per gal
	Performance Number	n	Standard Deviation	Range	Performance Number	n	Standard Deviation	Range	
A-153	58.6	29	0.7	3.2	59.0	16	6.6	2.7	0.01
A-154	102.8	26	1.8	6.1	102.7	19	1.4	4.5	4.17
A-155	108.2	28	1.9	8.8	108.7	14	1.9	5.2	3.57
A-156	73.2	26	2.1	7.3	72.0	14	1.3	4.6	4.01
A-157	121.5	25	2.7	10.8	122.2	14	4.9	17.6	3.89
A-158	103.7	29	1.5	6.8	103.3	17	1.1	4.2	2.88
A-159	118.5	28	2.7	11.4	123.5	16	3.7	12.2	4.53
A-160	103.9	28	1.4	6.6	103.2	14	1.5	10.4	4.04
A-161	109.3	28	3.5	12.9	95.6	14	3.0	12.0	3.00
A-162	75.2	26	1.3	5.5	76.8	17	0.8	3.1	0.00
A-163	80.5	26	2.1	9.3	80.5	17	0.8	3.1	3.16
A-164	105.1	25	1.3	6.4	106.1	17	1.5	5.7	3.00
A-165	123.0	25	3.2	12.5	125.7	14	5.3	10.2	4.55
A-166	112.3	26	2.2	8.9	110.6	17	1.5	6.7	4.53
A-167	97.1	28	3.1	13.5	94.8	18	2.2	7.7	3.82
A-168	97.3	26	3.9	17.3	92.6	18	1.8	6.0	4.52
A-169	115.8	27	2.3	9.6	116.6	16	3.4	17.0	4.43
A-170	75.9	28	1.6	6.9	74.7	15	1.1	4.3	3.92
A-171	59.0	28	1.1	4.1	60.3	17	0.5	2.1	0.01
A-172	106.5	26	1.8	7.7	105.9	17	1.2	5.3	4.55
A-173	124.0	26	3.0	5.9	125.8	17	4.2	19.4	4.59
A-174	77.0	27	1.3	5.5	75.2	16	1.0	3.4	4.00
A-175	115.1	29	2.2	10.2	115.6	16	2.0	8.9	4.48
A-176	102.7	23	1.4	5.0	102.4	14	1.0	3.2	4.37
A-177	77.2	23	1.3	4.2	75.7	15	1.1	3.2	4.53
A-178	117.8	23	2.4	10.7	119.0	14	2.0	6.1	4.57
A-179	105.3	22	1.2	5.1	105.5	15	1.7	7.2	3.84
A-180	101.5	29	1.5	6.4	99.6	16	3.1	11.9	3.04
A-181	104.5	30	1.5	7.0	103.9	20	1.2	4.5	4.56
A-182	108.0	28	1.9	8.3	108.6	21	1.6	8.1	3.89
A-183	101.1	27	1.1	3.9	101.4	19	1.2	4.3	4.53
A-184	101.3	31	1.1	4.0	100.8	18	1.0	4.6	2.96
A-185	109.2	26	3.0	12.1	122.1	18	2.3	8.3	4.44
A-186	105.0	26	1.0	3.5	105.5	19	0.9	3.8	3.93
A-187	113.8	26	1.3	5.5	113.7	17	1.1	4.1	4.59
A-188	105.0	25	1.1	4.7	105.3	17	0.9	2.8	3.02
A-189	54.6	24	1.1	4.6	54.8	17	0.2	0.7	0.33
A-190	116.5	26	1.7	6.4	117.3	17	2.4	11.0	4.65
A-191	87.4	25	2.3	9.2	85.9	16	1.6	5.4	2.17
A-192	115.8	24	1.6	6.8	117.1	17	1.4	4.6	4.58
A-193	79.2	25	1.4	6.1	79.0	18	0.9	3.0	1.91
A-194	122.9	24	3.4	14.7	125.2	13	3.9	15.7	4.48
A-195	121.4	24	2.5	10.4	123.6	17	2.8	7.1	4.64
A-196	59.0	24	0.8	2.9	59.1	16	0.5	1.8	0.46
A-197	100.9	25	1.1	4.2	99.7	16	1.1	4.0	2.97
A-198	61.2	25	0.7	2.9	61.8	15	0.5	2.1	0.00
A-199	104.5	25	1.3	6.9	102.5	14	1.2	4.1	3.87
A-200	116.4	23	2.0	11.0	117.8	13	1.9	5.5	2.90
A-201	118.9	24	1.8	7.7	121.8	14	2.3	9.6	4.44
A-202	116.7	23	1.6	6.1	117.8	13	2.0	7.4	3.59
A-203	116.2	25	1.6	7.7	116.7	14	1.6	6.5	4.57
A-204	104.2	24	1.7	6.6	103.8	13	1.8	6.1	4.18
A-205	79.5	23	2.0	7.2	79.6	13	0.9	3.2	2.97
A-206	103.1	23	1.4	5.0	103.5	13	0.7	2.3	2.97
A-207	62.4	25	0.8	3.6	62.8	13	1.0	3.5	0.55
A-208	124.7	22	3.5	15.4	126.7	13	5.5	16.9	4.53
A-209	124.3	25	3.4	13.2	125.2	12	0.9	3.2	4.51
A-210	122.4	25	2.4	8.7	124.4	15	1.4	5.9	4.47
A-211	161.5	25	1.5	5.4	161.0	12	1.4	4.3	2.97
A-212	80.6	27	2.1	7.7	79.5	15	1.2	4.3	2.93
A-213	110.1	27	1.7	7.2	111.3	14	1.2	4.3	3.03
A-214	115.7	27	2.4	9.3	114.7	14	1.4	5.3	4.52
A-215	73.1	28	1.7	6.8	74.7	16	1.1	4.9	0.00
A-216	107.5	28	1.2	4.8	107.6	14	1.5	6.2	3.86
A-217	92.6	29	3.5	12.1	90.1	13	2.1	9.0	4.79
A-218	79.2	28	1.5	5.5	78.1	15	1.0	4.1	3.71
A-219	59.5	26	0.8	3.4	60.0	13	0.6	2.2	0.46
A-220	120.8	26	2.7	9.9	122.1	12	1.8	7.6	4.64
A-221	115.2	26	1.5	6.7	116.1	14	1.5	5.9	4.63
A-222	119.6	25	3.1	11.1	121.8	11	2.7	9.2	4.18
A-223	117.7	22	1.5	5.6	118.3	13	3.3	13.3	4.62
A-224	100.1	25	1.3	5.2	97.9	14	2.2	6.8	4.12
A-225	114.6	25	1.3	5.7	114.6	15	1.2	3.7	4.56
A-226	59.6	26	0.7	2.8	60.1	13	0.5	1.7	0.54
A-227	107.5	26	2.6	12.8	107.2	13	1.7	5.9	4.02
A-228	101.4	22	1.7	7.8	100.6	18	1.8	9.1	4.68
A-229	115.5	24	2.1	10.2	115.1	11	1.7	5.4	4.61
A-230	62.0	23	0.5	2.0	62.9	10	0.6	1.9	0.61
A-231	125.9	21	3.4	13.4	126.3	10	6.5	18.3	4.51
A-232	107.9	23	1.2	5.5	108.0	11	1.1	3.8	4.07
A-233	116.9	25	1.3	5.7	116.1	13	1.3	4.5	4.53
A-234	104.7	24	1.3	5.6	104.4	13	1.3	4.5	4.53
A-235	117.7	25	2.2	7.3	118.0	13	1.9	5.6	4.60
A-236	120.1	26	2.5	8.7	121.3	15	2.5	7.0	4.65
A-237	104.1	25	1.9	7.8	103.2	12	1.5	6.1	4.05
A-238	101.5	25	0.9	3.2	100.5	12	1.6	7.1	4.54
A-239	109.5	25	1.7	5.4	109.9	15	1.9	6.0	3.98
A-240	115.8	21	2.1	9.3	116.0	14	1.5	5.0	4.39
A-241	112.9	21	2.0	9.6	113.1	13	1.3	4.0	2.96
A-242	113.4	22	2.0	7.6	114.0	14	1.3	5.0	4.31
A-243	125.9	23	3.4	12.0	126.6	12	2.9	11.2	4.58
A-244	115.5	24	1.5	5.6	114.5	14	1.6	6.0	2.97
A-245	119.3	23	3.0	12.0	117.8	14	2.6	9.1	4.23
A-246	105.4	21	1.3	5.9	104.6	13	1.9	2.5	4.03
A-247	98.5	21	2.2	8.0	97.3	15	3.0	9.3	3.00
A-248	102.8	20	1.5	5.7	101.9	15	2.1	7.9	4.28
A-249	114.7	23	1.9	6.7	115.9	15	1.5	5.6	4.17
A-250	101.2	23	2.4	9.5	99.4	12	2.2	8.2	4.49

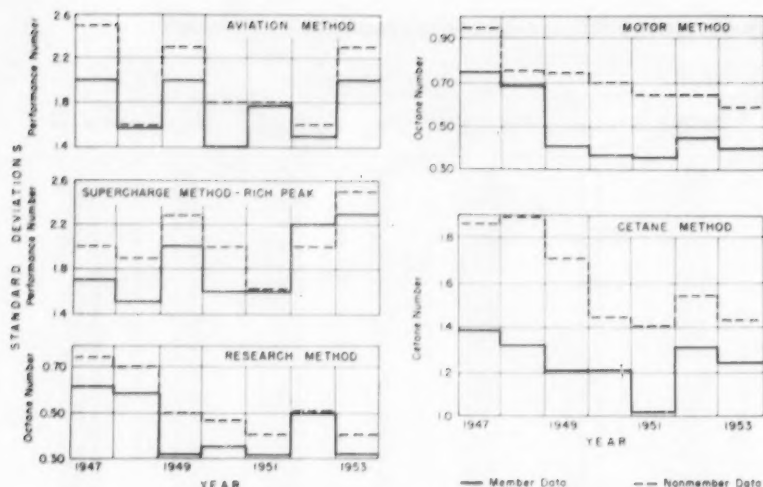


Fig. 9.—Precision of Rating Semiannual Samples, Members and Nonmembers, 1947-1953.

numbers, and averages and standard deviations were calculated in the usual manner. A plot of performance-number standard deviations *versus* performance-number level for motor fuel ratings is shown in Fig. 8. As plotted in Fig. 8, the average Research-Method standard deviation is 0.69 performance number, and the Motor-Method average is 0.62 performance number.

Nonmember Participation Tests:

Nonmember participants in the semi-annual motor fuel exchange tests have reported 1920 valid ratings for the Motor Method and 1729 valid Research ratings. The standard deviations for these results are plotted by years in Fig. 9, and, for comparison, member results on the same samples are shown in the figure. A steady improvement in precision of rating by nonmembers by both methods is indicated. In the analysis of the 1942-1946 data, differences between member and nonmember standard deviations were not so pronounced. The most significant change in the 1947-1953 data, compared to the 1942-1946 data, is the improvement by members in rating by the Research Method. For the 7-yr period the average standard deviation by member laboratories for rating all samples differed little from the member precision of rating the semiannual samples.

AVIATION FUELS

Ratings of Exchange Samples:

The basic data obtained by the Exchange Group on aviation fuel samples, A-153 to A-250 distributed in the past 7-yr period, are tabulated in Tables II and III. Supercharge-Method ratings

(at the rich peak) and supercharge ratings at 0.095 fuel-air ratio are shown in Table II. Aviation Method and Motor Method ratings of the aviation samples are compiled in Table III. All ratings have been expressed in terms of performance number, which is related to octane number by the formula:

$$\text{performance number (P.N.)} = \frac{2800}{128 - \text{octane number (O.N.)}}$$

A table for converting ratings in terms of isooctane plus milliliters tetraethyllead per gallon to performance numbers is included in the ASTM Manual of Engine Test Methods (2). In the performance number scale, a performance number of 70 is equal to an octane number of 88, 100 P.N. is equal to 100 O.N., and 115 P.N. is equivalent to isooctane plus 0.5 ml of tetraethyllead per gal. The performance number scale ends at 161, and ratings above this level are expressed in terms of detonation index (3). No samples rated by the Exchange Group in the last 7 years ex-

ceeded the 161 performance number level. There were 2088 valid ratings at the 0.095 fuel-air ratio for the 98 samples rated by the Supercharge Method in the 1947-1953 period. The results appear to be normally distributed and do not show any variation in standard deviation with respect to performance-number level. For Supercharge Method ratings at the rich peak, member laboratories reported 2229 valid results for the 98 samples. Here, again, the results are normally distributed, and there is no variation in precision with rating level (Fig. 10). For the Aviation Method, 2474 results were reported in the 7-yr period, and 1454 results were reported for ratings of the aviation samples by the Motor Method. Beginning in 1953, members began reporting Research-Method ratings for the aviation fuels, but not enough data are available for analysis.

Precision of Rating:

The yearly standard deviations for Aviation-Method ratings, for Supercharge-Method rich peak ratings, for Supercharge-Method ratings at 0.095 fuel-air ratio, and for Motor-Method ratings for the aviation samples are plotted in Fig. 3. Some improvement is indicated in the precision of ratings by the Aviation Method, but no significant change was noted in the precision by any of the other three methods of rating in the 7-yr period. The precision of the supercharge rich peak ratings—1.7 performance numbers—is definitely better than the 2.4 performance-number precision at the 0.095 fuel-air ratio. The Aviation-Method standard deviation for the 1947-1953 period is 1.9 performance numbers, and for the Motor Method it is 1.8 performance numbers.

How to Use the Precision Measures:

In Figs. 10 and 11 the standard deviations of the Supercharge and Aviation-Method ratings of the aviation fuels are plotted according to the average

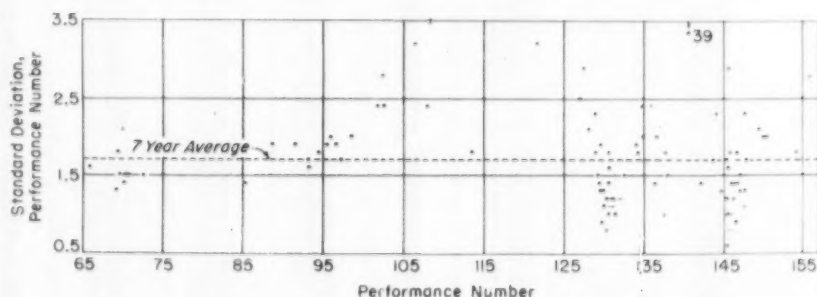


Fig. 10.—Precision of Rating Aviation Fuels—Supercharge Method *versus* Performance-Number Level.

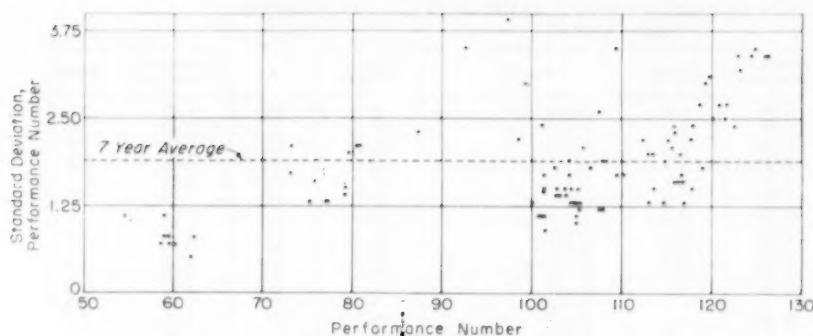


Fig. 11.—Precision of Rating Aviation Fuels—Aviation Method versus Performance-Number Level.

performance-number level of the samples. Figure 10 indicates no change in precision with rating level. Figure 11 indicates that the Aviation-Method ratings show the best precision at the lowest performance numbers and the poorest precision at ratings exceeding 118 performance numbers. Low lead contents of the fuels at the low rating level seem to indicate that the absence of lead makes the samples easy to rate, while the high lead content at high rating levels seems to indicate that high lead content makes a sample hard to rate. The data are not comprehensive enough to allow a conclusion; engine or instrument limitations may be the cause of poor precision above 118 performance numbers by the Aviation Method. Excluding the high and low values from the 7-yr average standard deviations for the Aviation and Motor Methods, the precision of rating by Supercharge, Aviation, and Motor Methods is about 1.7 performance numbers. Figure 12 shows the number of tests by any one of the three methods that will be required to give a desired precision. For ratings below 70 performance numbers by the Aviation or Motor Method, halve the number of ratings indicated by the scales; and for ratings by these two methods above 118 performance numbers, double the number of ratings indicated. This means, in effect, that for regular commercial aviation gasolines, Fig. 12 can be used as shown to indicate the expected precision of rating by the Supercharge, Aviation, or Motor Method in rating aviation gasolines. The Exchange Group test results indicate that fuel composition, excluding tetraethyllead content, has no effect on the precision of rating aviation fuels.

Nonmember Participation Tests:

Nonmember participants in the semi-annual aviation fuel exchange tests have reported 408 valid ratings for the Supercharge Method at the rich peak and 466 valid ratings by the Aviation

Method in the 1947-1953 period. The standard deviations for these results are plotted by years in Fig. 9, and, for comparison, member results on the same samples are shown in the figure. Members made a better showing in most years by both methods, having a poorer precision than nonmembers only once (1952) on Supercharge ratings. Figure 9 also indicates that some factors must influence ratings, since the standard deviations for nonmembers and members generally fluctuate in the same direction from year to year. These factors are too complex to determine from the data available.

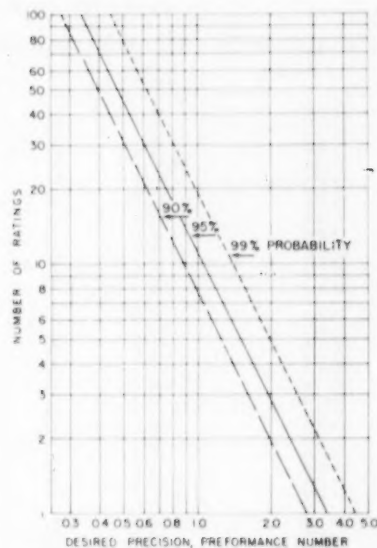


Fig. 12.—Number of Aviation, Supercharge, or Motor-Method Ratings of Aviation Fuels Required to Yield an Average Having a Desired Precision.

The number of ratings found on each of the three lines gives the indicated probabilities that the average rating will be within the desired amount of the true value.

Correlation of Motor and Aviation Ratings:

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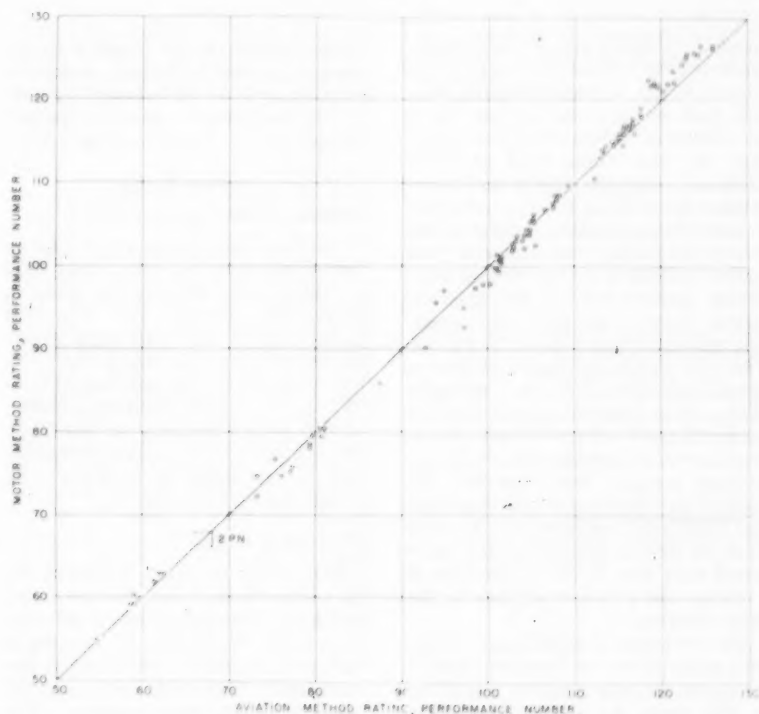


Fig. 13.—Correlation of ASTM Motor and Aviation-Method Ratings of Aviation Fuels, 1947-1953.

TABLE IV.—BASIC DATA ON DIESEL FUEL (D) SAMPLES IN CETANE NUMBER.
Cetane Method

Sample	Cetane Number	n	Standard Deviation	Range	Sample	Cetane Number	n	Standard Deviation	Range
D-200	48.0	24	1.54	5.7	D-249	53.2	15	1.57	6.0
D-201	53.4	20	1.10	4.1	D-250	49.9	16	1.83	6.3
D-202	30.9	23	1.25	4.3	D-251	43.9	12	1.32	4.1
D-203	63.4	22	1.62	7.3	D-252	55.2	13	1.41	4.6
D-204	56.7	21	1.15	3.6	D-253	50.7	15	1.05	3.6
D-205	44.5	21	1.50	6.1	D-254	55.5	14	1.66	6.5
D-206	63.0	19	1.66	5.8	D-255	57.6	14	1.27	4.6
D-207	53.5	20	1.37	5.2					
D-208	47.9	16	1.98	7.0	D-256	51.2	14	1.30	4.7
D-209	46.0	16	1.52	4.1	D-257	54.5	16	1.22	3.8
D-210	48.8	17	1.15	4.5	D-258	43.6	14	0.78	2.6
D-211	32.7	17	0.85	3.1	D-259	51.4	14	1.25	4.6
D-212	53.7	18	1.33	5.2	D-260	50.9	13	0.88	3.1
D-213	49.3	17	1.70	5.8	D-261	54.1	12	1.71	6.5
					D-262	51.7	13	1.03	3.4
D-214	49.0	18	0.93	3.3	D-263	45.8	14	0.98	3.5
D-215	42.1	19	1.72	5.9	D-264	39.1	15	1.29	5.2
D-216	55.3	19	0.95	4.5	D-265	41.7	15	1.06	3.6
D-217	29.7	18	1.07	4.2	D-266	51.1	15	0.98	3.3
D-218	53.2	19	1.06	4.1	D-267	52.4	14	0.96	3.3
D-219	43.9	17	1.38	4.5	D-268	57.3	11	1.49	5.8
D-220	46.5	17	1.56	4.4	D-269	60.7	11	1.46	4.5
D-221	41.0	18	1.66	6.5					
D-222	53.5	18	2.34	8.9	D-270	56.3	11	0.77	2.3
D-223	53.1	19	1.21	3.6	D-271	52.7	11	1.11	4.1
D-224	37.2	19	2.04	7.6	D-272	45.1	14	1.58	4.9
D-225	44.9	18	1.43	4.9	D-273	54.5	14	1.33	4.2
D-226	52.8	20	1.81	6.6	D-274	52.5	11	1.24	3.3
D-227	49.9	21	1.22	4.6	D-275	51.9	11	0.66	2.2
					D-276	44.9	11	1.45	4.2
D-228	48.0	21	1.22	5.2	D-277	33.1	11	0.93	2.7
D-229	50.0	23	1.84	6.7	D-278	44.3	12	1.43	5.2
D-230	49.8	20	0.63	2.4	D-279	33.9	13	1.50	4.6
D-231	45.1	21	0.76	2.5	D-280	56.6	13	0.86	3.5
D-232	41.8	21	1.32	5.9	D-281	51.4	12	0.90	2.4
D-233	48.4	21	1.39	4.7	D-282	48.2	14	0.84	3.2
D-234	53.5	22	1.44	5.4	D-283	43.5	13	1.45	6.1
D-235	55.4	18	1.11	3.4					
D-236	43.7	19	1.43	5.3	D-284	46.2	14	1.05	3.4
D-237	36.8	17	1.56	6.2	D-285	54.7	14	0.89	2.9
D-238	49.5	17	1.91	8.5	D-286	52.4	15	1.01	3.4
D-239	54.8	18	1.87	7.1	D-287	31.8	15	1.20	4.4
D-240	44.8	19	0.98	4.0	D-288	52.6	15	0.97	3.3
D-241	51.3	17	0.76	3.1	D-289	40.3	16	1.29	4.4
					D-290	42.0	16	1.11	3.5
D-242	51.9	18	1.42	4.8	D-291	53.9	16	1.49	6.3
D-243	47.7	18	0.67	2.5	D-292	50.9	15	1.10	4.4
D-244	37.6	17	0.71	2.4	D-293	50.6	16	1.44	5.9
D-245	51.0	18	1.45	4.7	D-294	32.3	16	1.34	4.9
D-246	52.1	17	1.36	5.7	D-295	39.2	13	0.45	1.4
D-247	50.6	18	1.16	4.5	D-296	42.0	16	1.04	3.6
D-248	45.0	15	1.27	4.7	D-297	50.2	15	0.99	3.6

General, Department of the Army, requested the National Exchange Group to analyze the exchange ratings on aviation fuels to determine if there was a correlation of ratings of aviation gasoline by the Motor and Aviation Methods. The objective of such a correlation is the use of the Motor Method in determining Aviation-Method ratings in the field, using the Motor-Method engine available in the mobile petroleum testing laboratories of the Quartermaster Corps. An excellent correlation was found and is shown in Fig. 13. The only significant departure from a direct equivalence of the two ratings is above 118 performance numbers, where Motor-Method ratings average 2 performance numbers higher than Aviation-Method ratings. Both Research Division I on Combustion Characteristics and Technical Committee J on Aviation Fuels of ASTM Committee D-2 have stated that they have no intention of replacing the Aviation Method by the Motor Method.

No correlation of supercharge ratings with either Motor or Research-Method ratings on aviation gasolines was found in this study for the Quartermaster Corps. Limited data indicate that a very rough approximation of super-

charge ratings can be obtained by increasing Research-Method ratings of aviation fuels in performance number by 28 performance numbers (supercharge rating = research rating + 28).

DIESEL FUELS

Ratings of Exchange Samples:

The basic data obtained by Exchange Group members in rating diesel fuels by the Cetane Method are given in Table IV, covering the 1947-1953 period. There were 1599 valid results for the 98 samples in this period. Cetane numbers for the fuels ranged from 29.7 to 63.4, with a standard deviation of 1.27 cetane numbers for the 7 yr. The results show a normal distribution and no variation of precision with cetane-number level (Fig. 14).

Precision of Ratings:

The yearly standard deviations for the Cetane Method since 1939 are shown in Fig. 2. Precision of rating deteriorated during World War II, reaching a high value in 1945. Since then it has consistently improved, with a 1953 precision of 1.09 cetane numbers. The average for the past 5 yr is 1.20, as against the 7-yr average of 1.27. The

1953 precision is some 32 per cent better than the 1945 precision.

How to Use the Precision Measures:

Present analysis indicates a continuation of the normal distribution of deviations in ratings by the Cetane Method, and the standard deviations found can be used with assurance in predicting the validity of cetane-number determinations on unknown samples. Figure 15 shows the number of ratings required to yield an average that will be within a desired amount of the true cetane number of a fuel. The lower dashed line is used where a 90 per cent probability is sufficient, the middle solid line gives 95 per cent probability, and the upper dashed line gives the 99 per cent probability values. This figure was computed on the basis of a standard deviation of 1.27 cetane numbers for 1947-1953.

Suppose one has obtained a cetane-number rating of 52 on a supply of diesel fuel. Is it safe to use in engines that require at least 50 cetane numbers? Figure 15 shows that once in twenty times (95 per cent line) the error of a rating will exceed 2.5 cetane numbers and that once in 100 times (99 per cent line) it will exceed 3.3 cetane numbers.

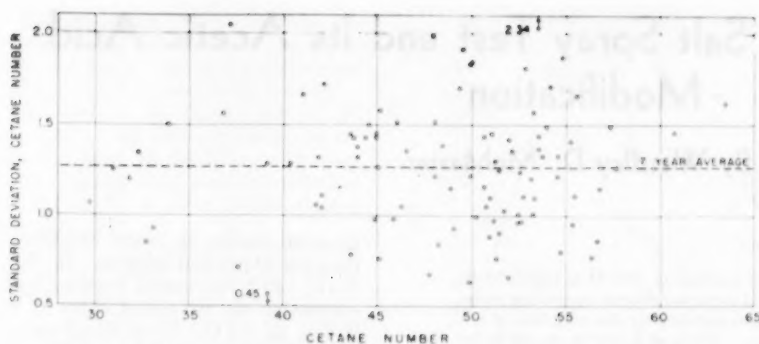


Fig. 14.—Cetane-Number Standard Deviation versus Cetane-Number Level.

Two more ratings, however, if they do not lower the average, will give assurance (99 times out of 100) that the fuel is at least 50 cetane numbers.

The discussion in the section on Motor Fuels relating to the analogous Figs. 6 and 7 applies to Fig. 15 as well. Tests must be independent if the figure is to apply. Other pertinent information, such as earlier ratings on the same stock or ratings on components, with knowledge of their blending relations, has the effect of additional ratings on the fuel. In short, the figure applies for independent ratings on an unfamiliar fuel.

Factors Influencing Precision:

A detailed study of a possible relationship between cetane number and humidity definitely indicates that humidity has no effect on Cetane-Method determinations. All results are normally distributed and show no variation in precision with cetane-number level (Fig. 14).

Nonmember Participation Tests:

For the 1947-1953 period, 627 valid results on 28 samples were reported by nonmember participants in the 14 semiannual tests. As shown in Fig. 9, both members and nonmembers have improved their precision of rating in the past 7 yr, the nonmembers showing a somewhat greater improvement. Members consistently obtained better precision in rating the same semiannual samples rated by nonmembers, and in no year did the members have a poorer precision than nonmembers. The nonmember precision for the 1947-1953

period was 1.61 cetane numbers, compared with a member precision of 1.25 cetane numbers. The member precision on all 98 samples in the 7-yr period was 1.27.

REJECTION OF RESULTS

All results included in this analysis were examined for conformance to standard engine operating conditions, and those results obtained on an engine not conforming to the prescribed limits of operation were rejected from the compilations. Statistical studies show that an occasional "wild result" will be obtained in this type of testing that cannot be explained on the basis of the test procedure. Mathematicians have studied this problem for many years and have used so-called "rejection criteria" for eliminating these random, diverse results. Prior to this 7-yr analysis, the rejection criterion applied was three times the standard deviation; that is, if a divergent test result differed from the average of all the results by more than three times the standard deviation, that result was rejected. Recently, electronic computers such as the Eniac have been utilized to study this problem, and the National Exchange Group adopted a rejection criterion determined by Grubbs (4) for use with the exchange tests. When the number of results (n) is less than 25, this criterion at the 99 per cent probability level rejects a few more "wild results" than the old criterion of three times the standard deviation would reject and, when the number of results is more than 25, retains a few more results. About $\frac{1}{3}$ of 1 per cent of all results by the five test

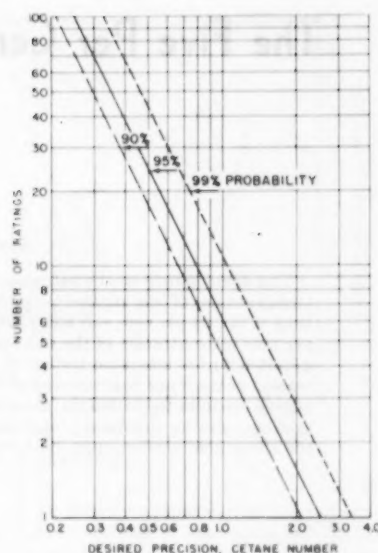


Fig. 15.—Number of Cetane-Method Ratings Required to Yield an Average Having a Desired Precision.

The number of ratings found on each of the three lines gives the indicated probabilities that the average rating will be within the desired amount of the true value.

methods have been so rejected in the last 7 yr, quite evenly distributed between the five methods, which is in excellent agreement with mathematical theory and is another confirmation of the approximate normality of the ASTM-DCC National Exchange Group fuel test results.

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- (3) Donald B. Brooks, "A Review of the Development of Reference Fuel Scales for Knock Rating," *Transactions, Soc. Automotive Engrs.*, Vol. 54, August, 1946, pp. 394-403.
- (4) F. E. Grubbs, "Sample Criteria for Testing Outlying Observations," *Annals of Mathematical Statistics*, Vol. 21, pp. 27-58 (1950).

The Five Per Cent Salt Spray Test and Its Acetic Acid Modification*

By Wardley D. McMaster

SYNOPSIS

The development of the salt spray test method in ASTM is highlighted. Group studies of this method are presented to show inherent operating problems of the 20 per cent salt spray, and their solution by the adoption of a 5 per cent concentration of the salt solution. Method B 117¹ is shown to be unsuited to the adequate testing of most plated items, and an acetic acid version of the 5 per cent revision of Method B 117 is presented as a suitable testing medium for cadmium, zinc, and chromium platings on steel or die-castings, and for anodized aluminum and phosphated aluminum. In fact, the acetic acid version appears to be acceptable for all salt spray testing.

THE salt spray as a test method has been developed under the aegis of the American Society for Testing Materials. Because it is fundamentally an empirical method, those making use of it have been only moderately critical of their tool; consequently, its development has taken 40 yr to date.¹

HISTORY

The test was introduced by J. A. Capp at the Seventeenth Annual Meeting of the Society in 1914.² For more than four years, he had used the test, which called for a saturated solution of salt and stated that it was designed to operate at 100 per cent relative humidity. The use of elevated temperatures, and acid or alkaline media, was also suggested.³

Suitable apparatus was described in 1918 by A. N. Finn⁴ of the National Bureau of Standards. For testing zinc, he hung panels vertically and used 6 to 7 psi air pressure for the atomiza-

tion of a 20 per cent solution. Rawdon, Krynetsky, and Finkeldey dimensioned such an apparatus in 1924 and improved the atomizer.⁵

In 1925, Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys began its work on the testing of non-ferrous alloys, proposing a 6 per cent salt solution, and in 1932 this committee published a review of its findings.⁶ This covered the effect of nozzle design, collection rate, etc., and suggested 20 per cent as an "easily controlled" solution. Margerum of the Naval Gun Factory took issue with the 1933 report of Subcommittee IV of Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys in which the 20 per cent salt spray was compared with the boiling nitric acid test, and the salt spray held unsatisfactory. He stated that 4 per cent was the proper concentration for testing stainless steel. From 1935 on, the use of the salt spray for testing electrodeposited coatings has been referred to as a "continuity test," thus recognizing a fundamental weakness of the test itself.

In 1937, E. H. Dix, Jr., and J. J. Bowman presented a paper⁷ calling for standardization and suggesting a 3.5

per cent solution as "easier to control" than the 20 per cent solution. In 1939, B 117-39 T was issued, covering both concentrations, for use at either 15 to 20°C or 35 ± 2°C. When Specifications A 166-40 T and A 166-41 T⁸ were issued, they specified a 20 per cent salt solution and 95 ± 5 F as the temperature.

Considerable argument is recorded for the years 1943 and 1944, the following points being made:

1. Variations of quality for equal thickness can be determined⁹ but not the measurement of coating thickness.

2. A wet fog is more corrosive than a dry fog.¹⁰

3. The corrosive effect of a 4 per cent solution is about the same as that for a 20 per cent solution, but slightly more severe¹¹ (also, May and Alexander¹²).

* Specifications for Electrodeposited Coatings of Nickel and Chromium on Steel (present designation: A 166-53 T), 1953 Supplement to Book of ASTM Standards, Part 2.

¹ E. M. Baker, Report of Committee B-8 on Electrodeposited Metallic Coatings, *Proceedings*, Am. Soc. Testing Mats., Vol. 43, p. 184 (1943).

² V. M. Darsey, "The Salt Spray Test," *ASTM BULLETIN*, No. 128, May, 1944, p. 31.

³ L. J. Waldron, "Basic Requirements in the Standardization of the Salt Spray Corrosion Test," *Proceedings*, Am. Soc. Testing Mats., Vol. 44, p. 654 (1944).

⁴ T. P. May and A. A. Alexander, "Spray Testing with Natural and Synthetic Sea Water. Part 2—A Study of Organic Coatings," *Proceedings*, Am. Soc. Testing Mats., Vol. 50, p. 1144 (1950).



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* This is a report of a task force of Subcommittee III on Spray Testing, of ASTM Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys. Active participants were: C. O. Durbin, J. A. Boylan, Fred Chase, Stafford Zerr, K. L. Raymond, Edward Fritts, Mark Beardslee, C. F. Nixon, and W. D. McMaster.

¹ Tentative Method of Salt Spray (Fog) Testing (B 117-49 T), 1952 Book of ASTM Standards, Part 2, p. 1037; Part 4, p. 602.

² J. A. Capp, "A Rational Test for Metallic Protective Coatings," *Proceedings*, Am. Soc. Testing Mats., Vol. 14, Part II, p. 474 (1914).

³ Historical extracts from ASTM records, presented by C. F. Nixon before the Electrochemical Society, 1950.

⁴ A. N. Finn, "Method of Making the Salt Spray Corrosion Test," *Proceedings*, Am. Soc. Testing Mats., Vol. 18, Part I, p. 237 (1918).

⁵ H. S. Rawdon, A. I. Krynetsky, and W. H. Finkeldey, "Types of Apparatus Used in Testing the Corrosibility of Metals," *Proceedings*, Am. Soc. Testing Mats., Vol. 24, Part II, p. 717 (1924).

⁶ "The Salt Spray Test," Report of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys, *Proceedings*, Am. Soc. Testing Mats., Vol. 32, Part I, p. 209 (1932).

⁷ E. H. Dix, Jr., and J. J. Bowman, "Salt Spray Testing," Symposium on Corrosion Testing Procedures, Am. Soc. Testing Mats., p. 57 (1937). (Issued as separate publication ASTM STP No. 52.)

Method B 117-44 T dropped the testing at 3.5 per cent salt concentration and many of the test requirements of the method were set forth in detail.

In 1948, V. M. Darsey and W. R. Cavanagh¹³ did some excellent and exhaustive work on the 20 per cent spray and apparatus which resulted in Method B 117-49 T, a most thorough-going presentation.

In 1950, C. F. Nixon of ASTM Committee B-3¹⁴ stated that he felt that too much reliance was being placed on the results obtained by the use of Method B 117-49 T. The author of this present article had previously pointed out in corporation circles that plating specifications calling for 32 to 48 hr salt spray were not in harmony with repeated exposures on city streets over a period of months, and claimed that good results obtained with the test could be definitely misleading.

In the meantime, many suppliers and users had been finding themselves in disagreement as to the acceptability of production items. Indeed, one user would reject and another accept the same item, both basing their decision on their use of ASTM Method B 117-44 T. Accordingly, a group of 14 cooperators was organized in 1945 to check the results delivered by this method. This group reached a number of the same conclusions that were later presented to ASTM by V. M. Darsey and W. R. Cavanagh,¹⁵ but disagreed on the collection rate limits and the concentration of the salt solution to be used.

STUDIES OF METHOD B 117

The group ran several cooperative tests with confusing results. Panels with a standard tin plate were secured and tested but were found to vary unduly. Zinc-plated steel panels with an average of 0.35 mil of zinc were tried and found unsatisfactory due to heavy corrosion. A thin paint film appeared to offer most promise, although there was little agreement as to the condition of the panels after the specified exposure.

A third series of panels was tested with improved control of panel quality using fender primer¹⁶ applied by dipping, and scribed with an X. These panels were exposed in the vertical position. The cooperators were impressed with the need for following the ASTM method most carefully. Previous tests

¹³ V. M. Darsey and W. R. Cavanagh, "Apparatus and Factors in Salt Fog Testing," Appendix to Report of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys, *Proceedings, Am. Soc. Testing Mats.*, Vol. 48, p. 153 (1948).

¹⁴ du Pont F475-1391, 0.6 mil dry film, baked 25 min at 390 F.

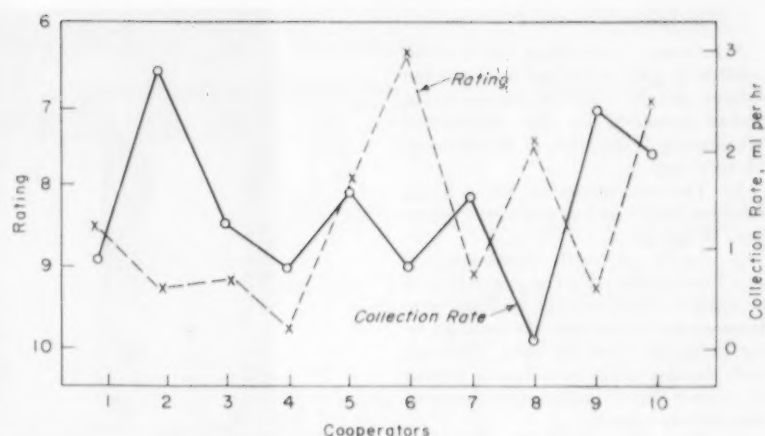


Fig. 1.—Rating versus Collection Rate.

had indicated the need of a wet spray. The results of this test began to indicate the solution of some of the operating problems, and those using 20 per cent and 5 per cent salt spray were nearing agreement. A detailed study of attendant conditions indicated that certain improvements in technique might still be made (see Table I).

TABLE I.—PAINTED PANELS.*

Co-operator	Salt, per cent	Collection Rate, ml per hr per 80 sq cm	Rating, Average of Four Test Panels
No. 1.	20	1.3	9.0
No. 2.	5	0.65	6.5
No. 3.	20	0.72	8.5
No. 4.	20	0.2	9.0
No. 5.	19	1.7	8.0
No. 6.	19	2.9	9.0
No. 7.	5	0.75	8.0
No. 8.	5	2.0	10.0
No. 9.	19	0.55	7.0
No. 10.	5	2.5	7.5

* Duration of test: 120 hr. Temperature and pH: As specified in Method B 117-44 T. Ratings: 1 = perfect; 10 = failed.

Analysis of all results to April, 1946, indicated that failure to agree resulted from the following:

1. Clogging of nozzles.
2. Dry spray due to poorly humidified air.
3. Dry spray due to inadequate supply of liquid at the nozzle.

The above conditions are reflected in inadequate collection test rates. It was proposed that the use of a 5 per cent salt solution would make the control requirements less critical and, by increasing the relative humidity, might possibly accelerate the test. The relation of low collection rates to severity of the test is indicated in Fig. 1. Here it is seen that, as the collection rate increased, the degree of failure also increased. In the case of cooperator No.

4, the trend is reversed, and it is not too clear in the case of cooperator No. 3.

The prevalence of "run-downs" on panels exposed vertically suggested that exposure at an angle might eliminate sensitivity to air currents and accelerate the test. A 15 to 20-deg angle from the vertical was suggested.

In the third test, the tin and zinc specimens again failed to yield results that were considered significant. A fourth test was carried out, therefore, with painted panels only, a sufficient number being supplied to permit running one per week for four consecutive weeks. Twelve cooperators used 5 per cent salt solutions, and the test panels were substantially identical in appearance at the conclusion of the specified exposure.

The question of uniformity had been raised, and the suggestion was offered that the addition of a "wetting agent" might be of value. This was tried without significant results. The use of 1 per cent acetic acid did not promote more rapid failure of the painted panels and actually seemed to retard the development of rust at points of failure. The use of a 15 to 20-deg angle for exposure of painted panels was first tried on this occasion and resulted in a most significant increase in the intensity of the test and was recommended as standard practice.

Table II gives the results of this program as averages of four test specimens.

These results led to increasing confidence in the 5 per cent salt spray as being the most easily controlled and therefore the most reliable method of testing the protection offered to metallic bases by chemical coatings protected by films of organic material. This conclusion was presented to ASTM Committee B-3 and resulted in withholding the adoption of Method B 117-49 T as standard.

RESULTS OF TESTING PROGRAM

Members of Committee B-3 were requested to give individual study to the matter and to consider the following points presented by the Accelerated Weathering Committee of the General Motors Corp.:

1. The concentration of salt in solution should be 3 to 6 per cent rather than 20 per cent.

2. Neither strength of salt spray is at all satisfactory for the evaluation of copper-nickel-chromium plating systems on steel or on zinc die-castings, or for cadmium plate on steel, although such developments as occur in testing do appear slightly faster with the more concentrated solution.

3. The 5 per cent solution, producing a relative humidity of about 98 per cent, is definitely superior to the 20 per cent solution with a relative humidity of only 85 per cent, in testing organic coatings.

4. For those who have large rooms for salt sprays, the weight of salt required and the time needed to make a 20 per cent solution, as compared with 5 per cent, are out of reason.

5. The 20 per cent solution promotes nozzle clogging, too dry a fog, and erratic results.

TABLE II.—TEST OF PAINTED PANELS.*

Co-operator	Collection Rate	Salt, per cent in Collections	Rating, Average of Four Panels
5 PER CENT SALT SPRAY			
No. 1..	1.2	5.7	4
No. 2..	1.15	5.0	4
No. 3..	1.1	7.1	5
No. 4..	1.0	5.0	7
No. 5..	1.2	5.0	5
No. 6..	1.1	5.4	5
No. 7..	2.4	4.8	9
No. 8..	0.7	8.0	5
No. 9..	1.7	5.0	5
No. 10..	1.5	5.8	5
No. 11..	1.2	4.5	5
No. 12..	1.0	5.1	5
5 PER CENT SALT + 0.01 PER CENT ALKYL ARYL SULFONATE			
No. 6..	1.9	5.3	4
No. 7..	1.8	4.98	9
No. 11..	2.0	5.7	5
No. 12..	1.0	5.0	4
20-deg Angle of Exposure:			
No. 12..	1.2	5.3	9
20 PER CENT OR 5 PER CENT SALT + 1 PER CENT GLACIAL ACETIC ACID			
No. 6..	1.6	19.7	4
No. 7..	1.9	19	7
No. 11..	1.5	4.5	4
No. 12..	1.0	5	5

* Temperature and pH according to ASTM Method B 117-44 T.
Ratings: 1 = perfect; 10 = failed.

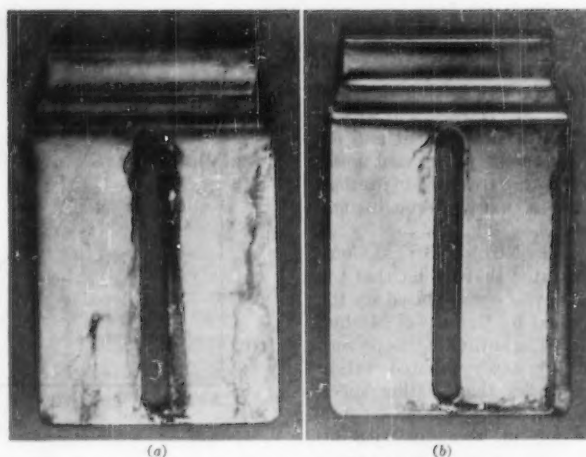


Fig. 2.—Chromium Plated Steel Part Exposed in 5 per cent Salt Spray.

(a) Half standard plate, regular salt spray, 500 hr.
(b) Standard plate, regular salt spray, 500 hr.

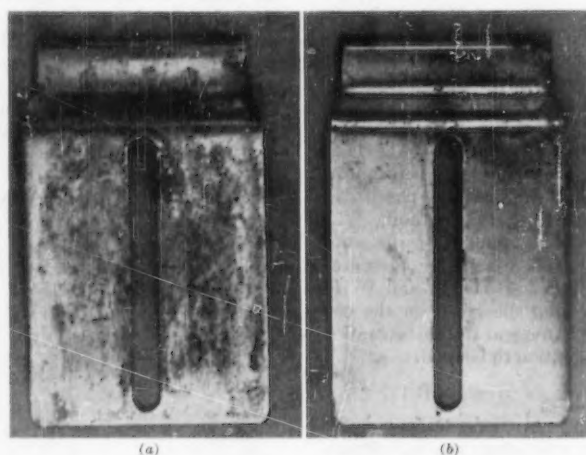


Fig. 3.—Chromium Plated Steel Part Exposed in the Acetic Acid Salt Spray.

(a) Half standard plate, acetic acid salt spray, 240 hr.
(b) Standard plate, acetic acid salt spray, 240 hr.

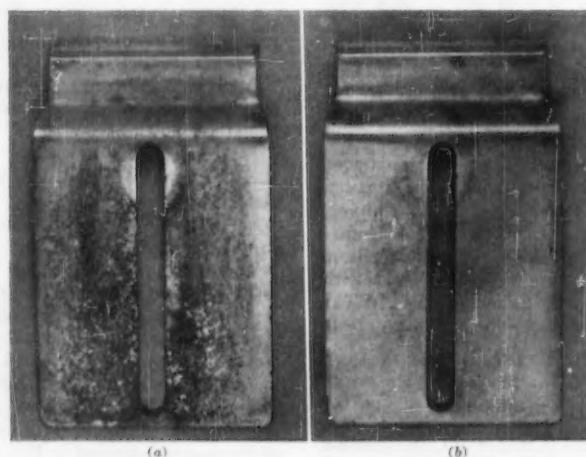


Fig. 4.—Chromium Plated Steel Part Exposed to Industrial Atmosphere.

(a) Half standard plate, 4 months' exposure on roof.
(b) Standard plate, 4 months' exposure on roof.

6. Since it is possible to obtain similar results with either concentration, there is little point in struggling with the more-difficult-to-control 20 per cent concentration.

7. The automotive, paint, and allied industries have used a 5 per cent salt solution for years and have found it acceptable. It has been approved as the superior medium by several laboratories of the Ordnance Dept., the Engineer Corps, the National Bureau of Standards, and other Federal units.

In view of the foregoing, and the confusion resulting from the retention of the 20 per cent solution in Government specifications, it is felt highly desirable that the suitability of the 5 per cent salt spray be recognized by all users. Subcommittee III on Spray Test of ASTM Committee B-3 accepted these findings and prepared the 5 per cent modification of Method B 117.

THE ACETIC ACID SALT SPRAY

Because of the unsuitability of the salt spray for testing plated parts, Subcommittee III of Committee B-3 appointed a working group consisting of W. D. McMaster, C. O. Durbin, and C. F. Nixon to study an acetic acid modification of the salt spray which had been presented to the committee for its consideration. This group enlisted the cooperation of members of the General Motors Corp. Accelerated Weathering Group, Chrysler Corp., and Parker Rust Proof Co. in this study.

The basic method had been originated by Nixon and made public in 1945.¹⁵ It was developed because of the failure of Method B 117 to reproduce typical service blistering of plated zinc-base die-castings. The method called for the addition of 1 per cent of glacial acetic acid to the 20 per cent salt solution, resulting in a pH of 3.2. Operation was carried out at 120 F. The group's studies showed that this was a valid method and that it was equally effective in the 5 per cent solution and at 95 F, although it required a longer time at the lower temperature. It was interesting to find that at either operating temperature the 5 per cent acidified salt solution was slower in developing blisters than was the 20 per cent acidified solution. This difference is in agreement with the findings of May and Alexander¹⁶ when they compared the cor-

TABLE III.—COMPARISON OF ACETIC ACID MODIFICATIONS OF 5 AND 20 PER CENT SALT SPRAYS AS OPERATED AT 95 AND 120 F USING PLATED ZINC-BASE DIE-CASTINGS.

	Standard Plate	Substandard Plate
Copper, mil.....	0.35	0.20
Nickel, mil.....	1.13	0.45
Chromium, mil.....	0.005	0.005
Total, mil.....	1.485	0.655

Cooperator:	Plate	pH	Hours to Failure at 95 F		Hours to Failure at 120 F	
			5 per cent Salt Concentration	20 per cent Salt Concentration	5 per cent Salt Concentration	20 per cent Salt Concentration
No. 1.....	Standard	3.2	60	55	37	34
	Substandard	3.2	45	29	24	13
No. 2.....	Standard	2.2	65	50	—	24
	Substandard	2.2	42	33	—	15
No. 3.....	Standard	3.2	70	48	45	40
	Substandard	3.2	24	24	18	12
No. 4.....	Standard	3.2	60	28	30	28
	Substandard	3.2	24	24	24	20

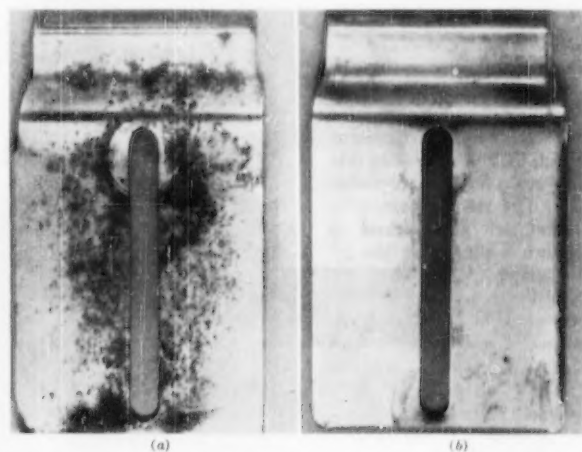


Fig. 5.—Chromium Plated Steel Part Exposed on Car License Plate Bracket.

(a) Half standard plate, one winter on car in Detroit.
(b) Standard plate, one winter on car in Detroit.

rosion of zinc in 3 per cent and 20 per cent salt sprays. However, this is only one application of the test and the possible universal application of a procedure is perhaps more important than the time element.

Complaints that adoption of the method would require a second salt spray led the group to initiate a study of the possibility of using the acetic acid salt spray for all items commonly tested in a salt spray. While this work is not complete in respect to the determination of all anticipated applications, such outstanding results were obtained that there was no hesitation in recommending to Committee B-3 that the method be accepted as an ASTM Tentative Method.

Naturally, the first step was to test copper-nickel-chromium plating on

steel, both in the 5 per cent salt spray and the 5 per cent acetic salt spray. Figures 2 and 3 illustrate the results. The standard plating of the figures has a total thickness of 0.001 in. Rust originating at the cut edges of this production part is to be ignored. In Fig. 2 the inferior plating shows more rust at the edges, but there is no significant difference otherwise after 500 hr in 5 per cent salt spray. This plating obviously more than meets the current specification: "No more than minor pinholes after 32 hr salt spray." After only 240 hr in the acetic acid salt spray as shown in Fig. 3, the half standard plate shows significant failure, representative of a service failure. The committee exposed identical plates on a roof for one winter and on the front bumpers of cars for

¹⁵ C. F. Nixon, "A Modified Salt Spray Test for Chromium Plated Zinc-Base Die-Castings," *The Monthly Review*, No. 32, November, 1945, p. 1104.

¹⁶ T. P. May and A. A. Alexander, "Spray Testing with Natural and Synthetic Sea Water. Part I—Corrosion Characteristics in the Testing of Metals," *Proceedings, Am. Soc. Testing Mats.*, Vol. 50, p. 1131 (1950).

one winter, in each case securing failures that match the acetic acid salt spray results. These are shown in Figs. 4 and 5. A check of some parts was made in the General Motors Research cycled humidity test, which involves dipping the part in dilute sulfuric acid and exposing it to varying humidity. Results identical to Fig. 3 were obtained after 285 hr.

TABLE IV.—COMPARISON OF ZINC AND CADMIUM PLATED STEEL IN THE ACETIC ACID SALT SPRAY AT 95 F.

Plate Thickness, mil	Hours to Failure	
	Zinc ^a	Cadmium
0.15.....	10	8
0.30.....	24	16 ^b
0.50.....	48	24 ^b

^a Approximately 50 per cent faster than plain salt spray.

^b These plates do not fail in plain salt spray.

These good results encouraged the study of cadmium and zinc platings on steel (see Table IV). This also led to the study of aluminum and aluminum alloys and the same items anodized and phosphated (Fig. 6), rust inhibiting oils, painted steel, and painted phosphated steel (Fig. 7). The results were quite satisfactory and are summarized in Table V. Figure 8 illustrates the results obtained with high copper-low nickel 1952 production plate in three total thickness ranges in the 5 per cent salt spray and acetic acid - 5 per cent salt spray, satisfactorily checking previous results. Again, the plain salt spray produced no developments in a reasonable exposure period.

In Tables IV and V, zinc and cadmium plating on steel are compared. In the plain salt spray cadmium appears superior to zinc, which is in accord with experience in sea-air environment. In the acetic acid salt spray, the cadmium fails more rapidly than the zinc. This is in accord with experience in the automotive industry, which long ago replaced cadmium with zinc on exposed parts. The author and many of his associates have reached the conclusion that corrosion of plated parts on automobiles is due more to the acidic industrial atmospheres found in cities, than to the use of salt on city streets, although the latter is a factor. A light fall of snow has been found to have a pH as low as 3.5, and to have produced all the usual evidences of service corrosion, on new cars standing in dealers' lots. It is recognized that a solution of oxides of sulfur may be the actual corrosive agent, but the use of acetic acid is preferable for test purposes.

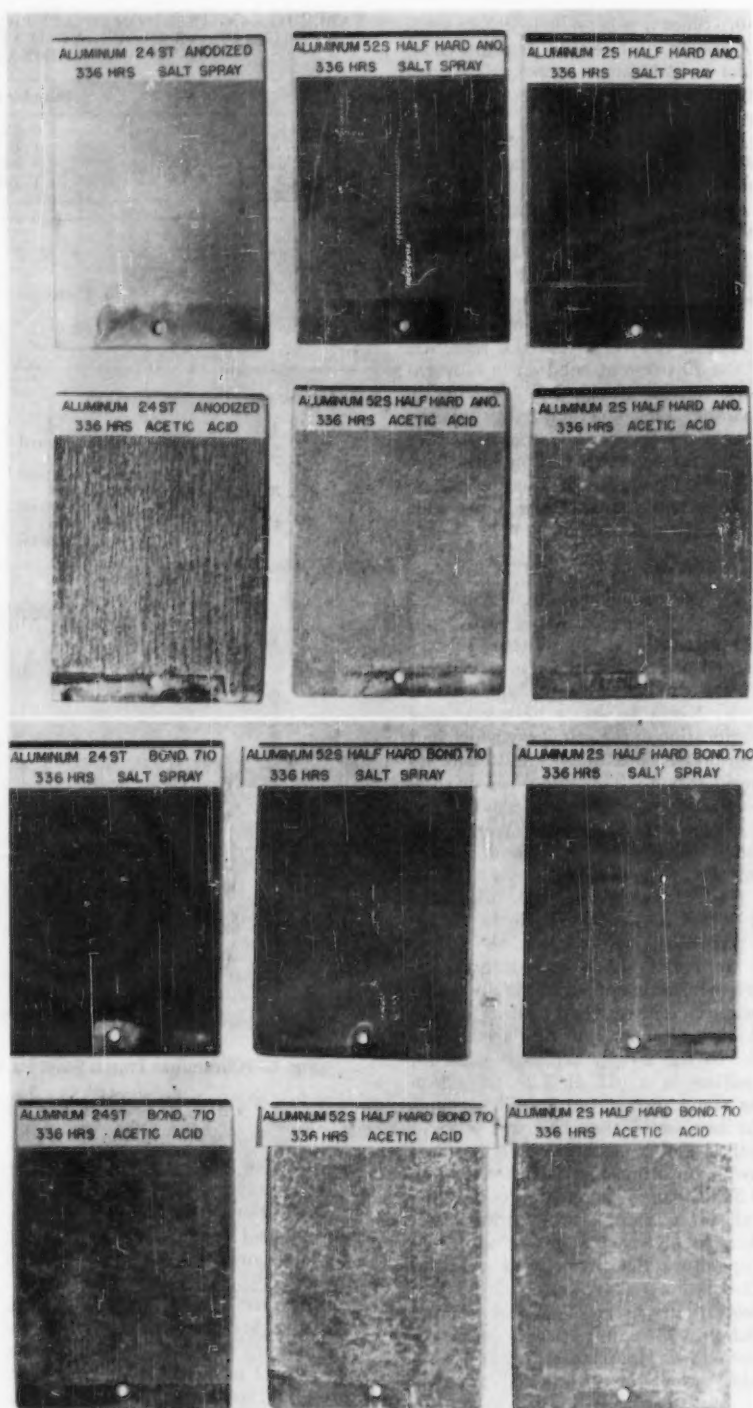
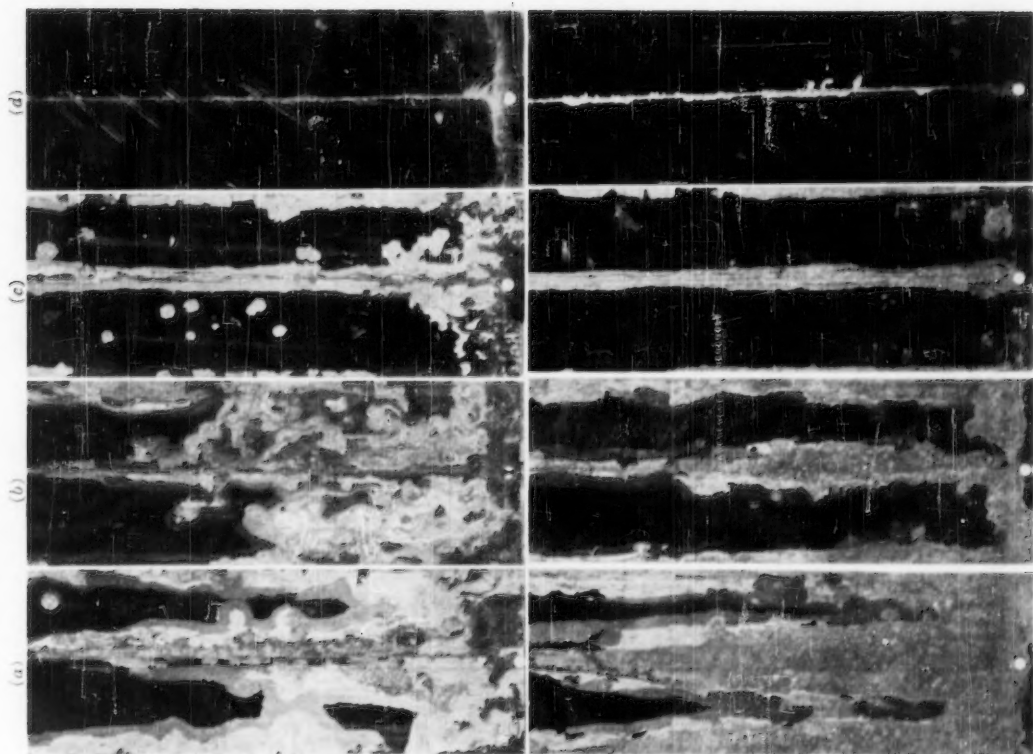


Fig. 6.—Comparison of Plain and Acetic Acid Salt Spray Exposures of Anodized and Phosphated Aluminum Alloys.



Top, salt spray. (a) Gilsonite bare steel, 216 hr. (b) Gilsonite Econocote B, 336 hr. (c) Gilsonite Bonderite 100, 336 hr. (d) Body System Bond 100, 336 hr. Bottom, acetic acid. (e) Gilsonite bare steel, 336 hr. (f) Gilsonite Econocote B, 336 hr. (g) Gilsonite Bonderite 100, 336 hr. (h) Body System Bond 100, 836 hr.

Fig. 7.—Comparison of Plain and Acetic Acid Salt Spray Exposures of Steel with Various Surface Treatments Followed by Painting.

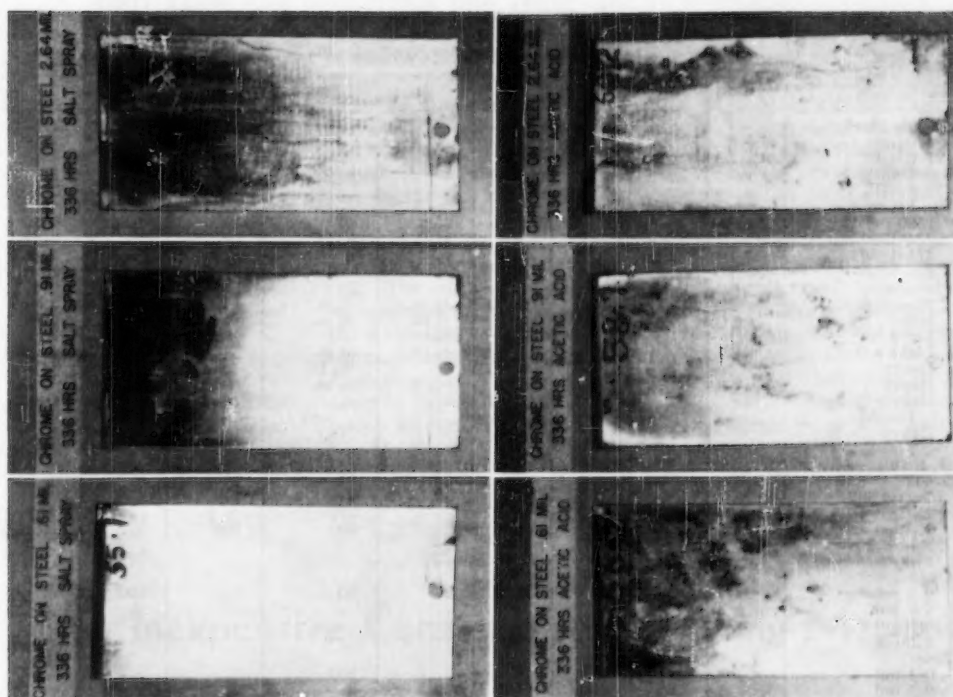


Fig. 8.—Comparison of Plain and Acetic Acid Salt Spray Exposures of High Copper - Low Nickel Plate on Steel.

TABLE V.—COMPARISON OF SALT SPRAY AND ACETIC ACID SALT SPRAY TESTS
OF ITEMS OF GENERAL INTEREST

		Average Results for Six Specimens ^b								
Hours to Inspection.....		4	8	24	48	72	96	168	240	336
No. 1 ^a	Chassis Black:							x		<5r
No. 2	1.0 mil				x					30p
No. 3	1.0 mil						x			5b
No. 4	0.5 mil				x					25b
No. 5	Dip Primers:									
No. 6	1520				x	25	40	50		65rb
No. 7	475-1520		Bad blistering			x	5	10	15	25pr
No. 8	475-1690						x	15	35	50pr
No. 9	475-1690			x	100		Wrinkled			100
No. 10	Phosphate:									
No. 11	None				x	1/4 in.	1/2 in.	1 in.		2 in.
No. 12	None				x	1/4 in.	3/8 in.	3/4 in.		2 in.
No. 13	Light				x	1/4 in.	1/4 in.	1/4 in.	1/4 in.	2 in.
No. 14	Light				x	1/4 in.	1/4 in.	1/4 in.	1/4 in.	1/4 in.
No. 15	Heavy				x	1/4 in.	1/4 in.	1/4 in.	1/4 in.	1/4 in.
No. 16	Heavy				x	1/4 in.	1/4 in.	1/4 in.	1/4 in.	1/4 in.
No. 17	Heavy (Body Finish)									OK
No. 18	Heavy (Body Finish)							1/2 in.		1/2 in. b
No. 19	R. I. Oils:									
No. 20	502				10	50	75	100	r	
No. 21	Tectyl 502			10	25	50	75	100	r	
No. 22	X-Rust 460A									5
No. 23	X-Rust 460A						50	100		
No. 24	Protex 15	x	25	50	100					
No. 25	Protex 15	x	50	100						
No. 26	Cadmium:									
No. 27	0.1 mil			x	10	25	50	75	100	
No. 28	0.1 mil		x	50	100					
No. 29	0.3 mil									OK
No. 30	0.3 mil		x	50	100					
No. 31	Zinc:									
No. 32	0.1 mil		x		50		100			
No. 33	0.1 mil		x	50	100					
No. 34	0.3 mil				x		20	30	50	60
No. 35	0.3 mil			x	50	100				
No. 36	Aluminum:									
No. 37	28 HH		x	25	100w					brn
No. 38	28 HH	x	50	100w						w
No. 39	2480	x	25	85	100					blk
No. 40	2480	x	25	75	100					blk
No. 41	248T-Alclad				10		15	20	55w	(100) (brn)
No. 42	248T-Alclad		x	25	75	100				w
No. 43	248T	x	10	35	60	85	100	w		brn
No. 44	248T	x	50	75	100					
No. 45	528 HH		5	10	25		30	w	40	(100) (brn)
No. 46	528 HH	x	50	75	100					
No. 47	578 H	x			5				10w	(100) (brn)
No. 48	578 H		x	50	100					w
No. 49	38 4-18H		x	10	50	w				(100) (brn)
No. 50	38 4-18H	x	50	75	100					w
No. 51	248T-Anodized									(100 gray)
No. 52	248T-Anodized						x	25	75	(100) (bl)
No. 53	528 HH			x	30	w				(100 grn)
No. 54	Anodized					10		50		(100 gray)
No. 55	28 HH									(100 bl)
No. 56	Anodized			x	30	50	90	100		gray
No. 57	24 ST &									(100 bl-brn)
No. 58	Bond. 710				xw	10	20	50	75	(100 bl-brn)
No. 59	528 HH &									OK
No. 60	Bond. 710							x	10	20
No. 61	28 HH &									OK
No. 62	Bond. 710							x	10	20
No. 63	"Chrome on Steel":									
No. 64	Code 50									OK
No. 65	Code 50							x	10	20
No. 66	Code 100									OK
No. 67	Code 100							x	10	30
No. 68	Code 300									OK
No. 69	Code 300							x	10	25
No. 70	Code 100									<5
No. 71	Code 100							x	10	25
No. 72	AES 15:									
No. 73	Steel			5						5
No. 74	Steel					10		20	40	80
No. 75	Die-cast			1		5			10	20
No. 76	Die-cast			10		35				55
No. 77	Die-cast on car									2 Months
No. 78	Die-cast on roof									35
No. 79	Steel on car									75
No. 80	Steel on roof									25
No. 81	Steel on roof									50

^a Odd numbers: 5 per cent salt spray. Even numbers: acetic acid salt spray.

^b Ratings in per cent of failure or inches:

b = blisters

w = white

x = initial breakdown

brn = brown

g = green

r = rust

bl = black

p = peeling

d = discolored

tr = trace

Just as this program was being concluded, attention was drawn to the rather rapid failure of 1954 production-plated parts throughout the industry. Parts on new cars were showing severe rusting after less than two months of use in Detroit. Samples were secured for study and found to have the specified adequate plating thickness. New parts ran 450 to 2300 hr in salt spray before pinhole corrosion occurred. However, in the acetic acid modification of the salt spray, failures were obtained in 16 to 48 hr. These failures were identical in every stage to those found on failed parts taken from cars in service.

CONCLUSIONS

There are several points that may properly be considered in connection with the evaluation of salt spray tests, particularly where plated items are involved.

1. The salt spray is a means of com-

paring the quality of paint systems, rust-proofing systems, and plating systems as well as film thickness. Since plated standards cannot be produced without variation, one should not use the salt spray to differentiate between plates that produce one spot per square inch, and two spots per square inch, even though the difference be 100 per cent. Rather, the test should be used to develop the type of differences illustrated in this paper. This fact was recognized by some many years ago.¹⁷

2. The salt spray is intended to be an accelerated test. It is evident that the acetic acid modification is not only more accelerated but is more universally applicable. It is not reasonable, however, to expect test developments to match service developments perfectly

¹⁷ C. H. Sample, "Use and Misuse of the Salt Spray in the Testing of Electrodeposited Metallic Coatings," *ASTM BULLETIN*, No. 123, August, 1943, p. 19.

in color or other appearance. It is sufficient, for the present, to be able to say: "That item that first fails in test will first fail in service," or better: "If it does not fail in x hours in test, it will probably withstand 1 yr of average service exposure."

3. The temperature at which the test is run determines the speed with which a point of failure is reached. If necessary, a temperature of 120 F may be used in place of 95 F, but for certain purposes the higher temperature cannot be tolerated. The best temperature for a "universal test" seems to be 95 F.

This history of ten years' study of the salt spray by the task force is presented with the hope that it may encourage a wider acceptance of the 5 per cent salt spray for general testing. The acetic acid salt spray is offered as a test for all plated parts, anodized and phosphated aluminum and its alloys, and such other items as may be desired.

An Inexpensive Constant-Load Testing Machine*

By M. E. Clark and O. M. Sidebottom

SYNOPSIS

This paper presents the design and the features of an inexpensive testing machine for application and maintenance of constant loads. Performance characteristics indicate that the machine is well suited for maintaining the load constant within small limits of variation over extended periods of time under variable head speeds.

MANY service applications call for structural members that must withstand static loads for long periods of time. When these loads are of such magnitude as to produce inelastic action, it is of great importance to determine by means of tests the load-deformation characteristics of such members. For many years these characteristics have been observed from tests made in the conventional screw- or hydraulic-powered testing machines. This conventional type of machine, however, is not well suited to investigate the time-sensitive inelastic behavior of load-carrying members, because it is a deformation-producing machine and not a load-producing one—that is, the load on the member falls off as the inelastic deformation increases with time, since

the head of the machine does not follow the movement of the specimen. The results of such a test give an inaccurate representation of the load-deformation characteristics in the inelastic range. The trend in recent years has been

toward the use of these more common deformation-producing machines with their inherent disadvantages for research on members involving inelastic action.

The true representation of the load-deformation characteristics in the inelastic range can be obtained only in a constant-load machine. The simplest such machine is a dead-load machine, the first of which was developed and used by Peter Barlow¹ as far back as about 1800. Adaptations of the dead-load machine have been used to study the inelastic behavior of beams, and

M. E. CLARK, Assistant Professor, Department of Theoretical and Applied Mechanics, University of Illinois, has been concerned recently with time-sensitive inelastic behavior of ductile members.



O. M. SIDEBOTTOM, Associate Professor, Theoretical and Applied Mechanics Department, University of Illinois, has been concerned primarily with the influence of inelastic deformation on the load carrying capacity of members.

* This paper was presented at the Fifty-seventh Annual Meeting of the Society, June 13-18 in Chicago, Ill.

¹ Peter Barlow, "A Treatise on the Strength of Materials," Lockwood and Co., London (1867).

significant differences were observed between results obtained from dead-load tests and those obtained from conventional tests.² One of the important differences observed was the reduction in the ultimate load-carrying capacity of a structural steel beam under sustained loading. This information posed the question as to whether similar reductions would be observed when a member of the same material was subjected to an eccentric column load. Development of a testing machine with the desired capacity of 100,000 lb utilizing the dead-load principle was not considered appropriate for testing this type of member since, for loads of the magnitude required, it would be necessary to use a lever system. This was considered to be prohibitive for reasons of space and framing requirements, instability, and lack of adaptability as to length and end conditions of the specimen. It was felt that a testing machine using a hydraulic loading principle would eliminate most of these disadvantages. Therefore, the construction of a constant-load machine was undertaken, and this paper describes its design and performance.

MACHINE DESCRIPTION

After considering several preliminary designs, the testing machine sketched in Fig. 1 was constructed. The machine consists basically of the eight component parts listed on the figure. The frame of the machine is composed of a concrete base in which are mounted four 2-in. diameter steel columns having recesses appropriately spaced so that the upper head can be adjusted to accommodate test members up to 8 ft in length.

The diameter of the plunger of the jack needed to supply the capacity of 100,000 lb was, of course, dependent on the magnitude of the available pressure. Commercial cylinders of compressed nitrogen having pressures of 2200 psi were available as was a 200-ton hydraulic jack having a plunger with a cross-sectional area of 53.4 sq in. This combination was more than sufficient to satisfy the ultimate load capacity requirement. The nitrogen and the hydraulic fluid (oil) were coupled by a 2½-gal Greer hydro pneumatic accumulator which has an expandable neoprene diaphragm separating the nitrogen and the oil.

In order to maintain a constant load on the test specimen, the hydraulic fluid pressure must remain constant regard-

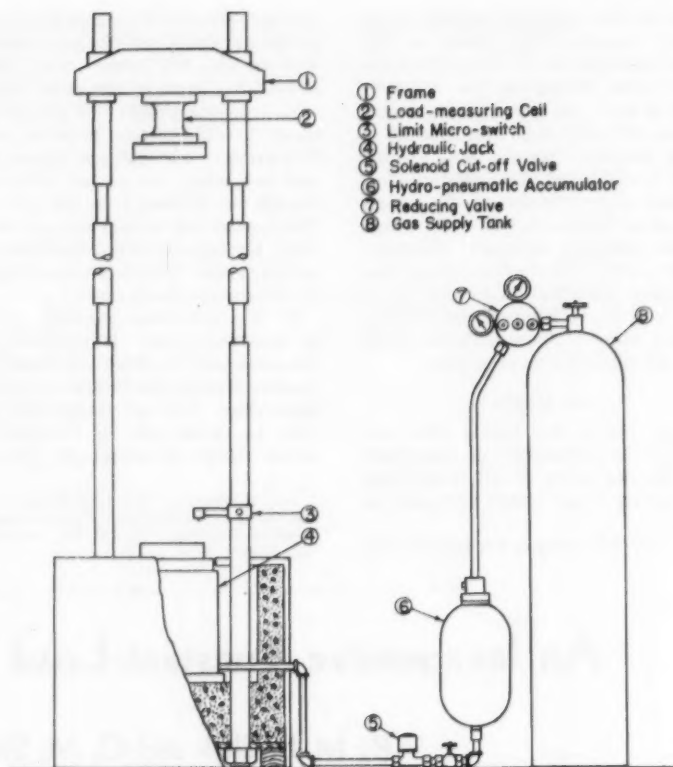


Fig. 1.—Sketch of Constant-Load Testing Machine.

less of deformation in the specimen. For any given load on the plunger, pressure in the nitrogen tank must be reduced to the required pressure level and maintained at that level throughout the loading period. It is apparent then that the operation and accuracy of the reducing valve is the critical factor in the operation of the machine. A Hoke-Phoenix ballast type reducing valve was selected for this purpose.

The load measuring unit was a hollow compression cylinder of heat-treated alloy steel having an inside diameter of 4 in. and a wall thickness of 0.10 in. Three pairs of longitudinal and circumferential SR-4 bakelite strain gages were spaced at 120-deg intervals around the inside wall. The longitudinal gages were connected in series as were the three circumferential gages used to form the dummy gage for temperature compensation. A standard strain indicator thus indicated the average deformation of the load cell, and an increment of 1 microinch was determined by calibration to be equivalent to approximately 25 lb of load.

The solenoid-operated cut-off valve actuated by a limit microswitch was introduced into the hydraulic fluid line to limit the travel of the plunger of the jack after failure of the test specimen. Since the solenoid was not required to

open the cut-off valve against the pressure in the system at the time, a relatively inexpensive low-pressure (75 psi) valve was found to be satisfactory. Before installation the valve housing was proof-tested by subjecting it to pressures up to 3000 psi.

From the above description, it is apparent that the total cost, including parts, machining, and assembly, is only a small fraction of the cost of a conventional testing machine of similar capacity.

SOURCES OF ERROR

In the testing machine as built there are four possible sources of error: (1) temperature changes in the ballast chamber of the reducing valve; (2) friction forces on the plunger; (3) viscous losses in the oil line; and (4) resistance changes in the strain gages in the load cell. These sources will be discussed in detail in the following paragraphs.

The pressure on the plunger is regulated by adjusting the pressure in the ballast chamber of the reducing valve. Once the pressure is adjusted to the desired value, the ballast chamber is closed off. The reducing valve opens to emit more gas from the tank whenever the movement of the plunger reduces the pressure in the system only

² M. E. Clark, H. T. Corten, and O. M. Sidebottom, "Inelastic Behavior of Ductile Members Under Dead Loading," Bulletin Series No. 426, University of Illinois Engineering Experiment Station (1954).

slightly below the pressure in the ballast chamber. Since the gas in the ballast chamber is of constant volume, the pressure-temperature relations are governed by the combined gas law. The temperature can be changed either by the changes in the surrounding atmosphere or by the cooling effects of the expanding gas coming from the tank. In the tests made with the machine thus far, these effects were found to be insignificant since the room temperature remained nearly constant and the plunger movement was relatively slow (therefore the rate of gas movement was also slow) except when failure of the specimen took place.

Friction forces between the original plunger of the hydraulic jack and the inverted U-ring seal resulted in a drop-off in load on the specimen when the specimen deformed. For all practical purposes, these friction forces were negligible after the surface of the plunger was polished.

The viscous losses in the oil line result in a pressure differential between accumulator and plunger and, hence, drop-off in load. At high head speeds, this drop-off in load may become significant.

No method is known by which the errors in load measurement indicated by the electrical strain gages in the load cell can be eliminated. However, these errors are relatively small and can be minimized by periodic calibration.

It should be realized that, for a given load at low head speed, the ability of the machine to maintain the load is dependent on the area of the plunger. As previously indicated, one source of error is the influence of temperature on the pressure in the ballast chamber of the reducing valve. Since the gas in the ballast chamber is of constant volume, a given change in temperature will result in a certain variation in pressure. This variation in pressure will be essentially independent of the magnitude of the pressure; therefore, the percentage variation in pressure due to temperature changes is decreased when an increase in pressure occurs. Since, for a given load, a small plunger would necessitate a larger pressure, the effect of error due to temperature would be reduced. Furthermore, friction losses would be expected to decrease with plunger diameter.

PERFORMANCE CHARACTERISTICS

Since the construction of this machine, three types of tests have been made with the equipment to determine its ability to maintain the load under various conditions of operation. These include conventional compression tests, tests of eccentrically loaded columns,

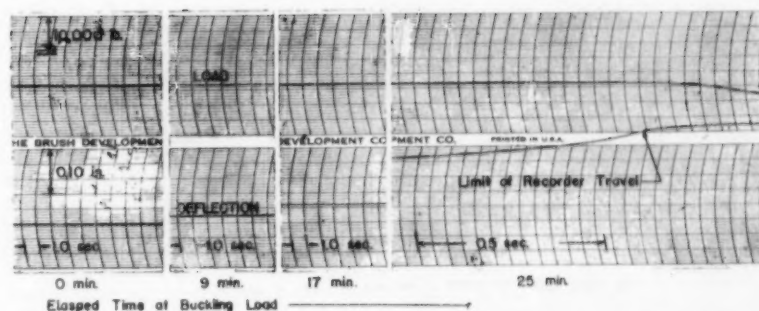


Fig. 2.—Oscillograph Records of Load and Lateral Deflection of a Column at Its Buckling Load of 12,900 lb.

and simulated load conditions to investigate rate of loading characteristics.

Low-carbon steel compression specimens of various diameters (designed in accordance with ASTM Methods E 9-52 T² for specimens of medium length) were loaded through the yield range. Since no upper yield point was detected, the specimen yielded at constant load for several minutes during the spread of inelastic deformation throughout the specimen. During this time the load cell did not indicate any variation in load.

In accordance with the primary purpose for its design, approximately ten eccentrically loaded, low-carbon steel columns were tested in the machine. These columns had a 1 by 1-in. cross-section, an l/r ratio of 60, and an eccentricity of 0.31 in. Direct inking oscillograph records showing the behavior of one such column at its buckling load are shown in Fig. 2. In this test the load was applied in steps until the buckling load of 12,900 lb was applied. The column then continued to deform at constant load until collapse took place. The lateral deflection was measured by a U-shaped, aluminum alloy deflectionometer that had SR-4 strain gages mounted at the critical section of the U. One unit of the oscillograph recorder was connected to the deflectionometer, and the other was connected to the load cell. Since failure at the buckling load did not occur until 25 min had elapsed, only portions of the oscillograph records at 0, 9, 17, and 25 min elapsed time are shown in Fig. 2. Direct readings of the load cell were taken concurrently with the autographic recordings of the oscillograph. The load cell indicated an increase in load of 1 per cent during the first 8 min at the buckling load but indicated constant load during the remaining 17 min of the test. The autographic record then shows that the load did not fall off until less than 1 sec before

final collapse of the column when the total lateral deflection was approximately 0.20 in.

Simulated load conditions, in which a hydraulic jack was loaded in the testing machine in place of a specimen, were used to investigate the machine characteristics under various head speeds (the hydraulic jack considered here should not be confused with the one incorporated in the machine). The various speeds were obtained by adjusting the opening of a needle valve to control the flow of oil out of the hydraulic jack.

In Fig. 3 are shown oscillograph records of head travel (as measured by the U-shaped deflectionometer) and load (as measured by the load cell) for two different loads and head speeds. Conditions that show the machine in possibly its worst light were imposed for the test where the head speed was 0.475 in. per min at a load of 10,600 lb (see Fig. 3(a)). At this extremely high head speed the drop-off in load of approximately 4 per cent is no doubt due mainly to viscous losses in the oil line. Also at this low load, the friction forces on the plunger would be greater percentage-wise than for larger loads. In Fig. 3(b), however, with the head speed at 0.135 in. per min and the load increased to 42,400 lb, these foregoing effects were reduced appreciably and a drop-off in load of approximately 1 per cent was found.

In Table I are shown the results of direct measurements of load and head

TABLE I.—EFFECT OF RATE OF HEAD TRAVEL ON LOAD.

Head Speed, in. per min	Load, lb		
	Before Run	Minimum During Run	After Run
0.08	16 000	15 850	15 900
0.71	16 000	15 500	15 875
0.03	26 800	26 700	26 800
0.12	26 800	26 600	26 800
0.34	26 800	26 400	26 700
0.17	37 500	37 300	37 500
0.27	37 500	37 300	37 500

² Tentative Methods of Compression Testing of Metallic Materials (E 9-52 T), 1952 Book of ASTM Standards, Part 1, p. 1403; Part 2, p. 1222.

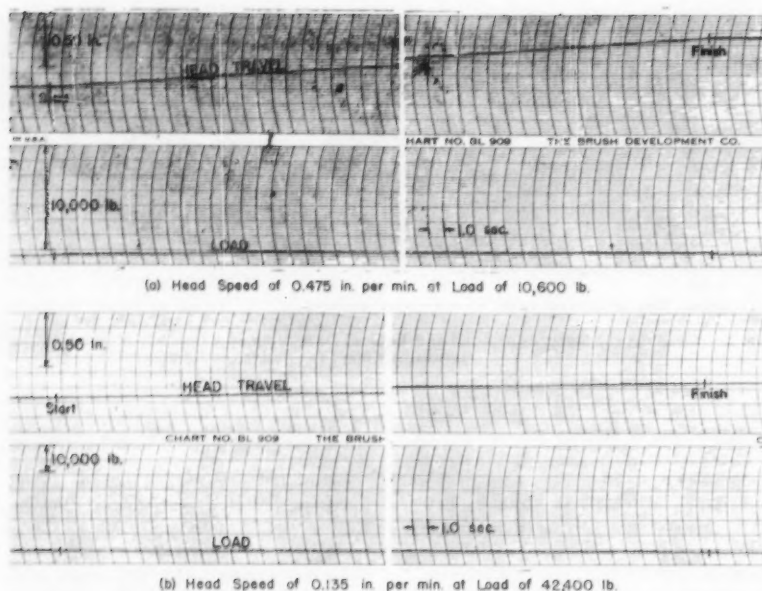


Fig. 3.—Oscillograph Records Showing Relations Between Head Speed and Load for Simulated Load Conditions.

travel. For any given run, three load readings were recorded: (1) the reading before head travel started, (2) the minimum reading during head travel, and (3) the reading after head travel had ceased. The load data shown in Table I were obtained using the load cell and were substantiated by direct Morehouse ring measurement. These data indicate that for reasonable values of head speed the load was accurately maintained. Since the final load reading after head travel ceased was usually slightly lower than at the start of the run, indications are that the friction on the ram must have accounted for the difference. Substantiation of this fact was made when accurate measurement of the pressure on the ram showed a complete return to the originally imposed value.

APPLICATIONS

The combination of high-pressure gas supply, ballast-type reducing valve, and

accumulator is a convenient and inexpensive means of controlling the pressure of liquids in any system in which the volume change does not exceed the capacity of the accumulator or accumulators. Such systems include conduits and pressure vessels subjected to creep or time-to-rupture tests. By introducing a hydraulic jack, loads can be controlled instead of pressures. Deformation-independent loads exist in many service applications, and this method of load control is an expeditious means of simulating those conditions. Examples of research in which the time-sensitive behavior of the material influences the behavior of the member include tests of eccentrically loaded columns of concrete or of steels, creep or time-to-rupture tests of members which necessitate loads of such magnitude that dead loads are not practical, or any experiments of this general nature where failure to maintain the load would result in an inaccurate

representation of the load-deformation characteristics.

Acknowledgments:

The development of this equipment was a part of the work of the Engineering Experiment Station of the University of Illinois, W. L. Everitt, Director, in the Department of Theoretical and Applied Mechanics, T. J. Dolan, Head. The interest and assistance of H. T. Musgrove in the design and construction of the apparatus are gratefully acknowledged.

DISCUSSION

MR. LEWIS F. HERRON.¹—A set-up similar to that discussed by the authors has been used by the writer for soil load testing. The hydro-pneumatic accumulator was not used, instead the nitrogen from the pressure regulating valve was discharged directly to the hydraulic jack. It was found that the nitrogen leakage was not excessive when a good jack was used. It was felt that the system without the accumulator gave more reliable results due to the fact that with a small amount of leakage volumetric expansion due to increase in temperature would not cause overpressure.

MESSRS. M. E. CLARK AND O. M. SIDEBOTTOM (*Authors' Closure*)—The authors were glad to hear of the successful application of the hydraulic loading principle as described in their paper by another investigator. It is worth while to know that the more viscous liquid in the system as described could be eliminated (along with the accumulator) if a good seal was provided in the hydraulic jack. This was not possible with the jack that was used since difficulty was encountered in keeping the oil in the system to say nothing of preventing escape of the nitrogen. If the oil can be eliminated, better performance would be expected especially at high speeds where the viscous oil losses would be appreciable.

¹ President, The James H. Herron Co. Cleveland, Ohio.

Plastics-in-Building Conference Reveals Need for Standards

MORE than 500 registrants representing plastics technologists, builders, and architects attended the Conference on Plastics in Building, held on October 27 and 28 in Washington, D. C. The conference was jointly sponsored by the Society of the Plastics Industry, the Manufacturing Chemists' Assn. and the Building Research Advisory Board (BRAB) of the National Academy of Sciences—National Research Council, and was organized and conducted by the Building Research Inst. (BRI) also of the Academy—Research Council. This was the second conference devoted to a specific building material, the first having been on porcelain enamel.

The plastics industry in sponsoring this conference had as an objective the presentation of a true account of the characteristics and potentialities of plastics for appropriate uses in building, so that the architect and the builder would be in a better position to design for and use them properly.

One of several papers in the introductory session was presented by Albert G. H. Dietz, Massachusetts Institute of Technology, his subject being "Physical and Engineering Properties of Plastics." He described the properties of a number of different plastic materials which make them interesting for use in building but which may at the same time limit their usefulness. Of particular importance for consideration in design is the relationship of elastic to plastic behavior in plastics and the dependence of these factors on the temperature. The rate of loading also influences this relationship. Materials exhibiting plastic behavior are subject to creep and design must take this fact into consideration so that the amount of creep in service will be negligible. By taking these factors into account, plastics parts can be designed for long-time loading and long-time allowable deflections.

Other properties described by Professor Dietz included directional strength effects caused by orientation of molecular structure by drawing and in laminates by orientation of reinforcing material. He pointed out that the thermal expansion is greater for plastics than for many other materials and this must also be taken into account in design. Durability characteristics including resistance to corrosion and to weathering were outlined, and it was pointed out that long-time weathering data are not available on many plastics because of their relative newness.

In the second session, a number of specific uses of plastics in building were

described. Applications included light-transmission panels; glazing and interior illumination; thermal insulators and vapor seals; structural panels; surfacing and decorative uses; and plastic pipe, ducts, and conduits. During the lively discussions which followed the presentation of these papers, a number of questions were posed which could not be answered with information available, thus revealing the need for further studies in providing data to the architects and builders.

The third session was devoted to standards and codes with papers by Gordon Kline, National Bureau of Standards, and F. G. Rarig, Rohm & Haas Co.

Dr. Kline, long active in ASTM and former Chairman of Committee D-20 on Plastics, explained that the builder, familiar with the long-established standards for metals, concrete and wood, wants similar technical specifications for plastics. Because plastics are relatively new and dynamically developing materials of construction, they do not lend themselves to the static standards often used for other materials—they require a dynamic type of standard which will serve as a yardstick of quality in a diverse and changing system. Such dynamic standards provide a medium in which the collective judgment and experience of engineers representing producers and consumers can guide both groups in the further development and use of new materials in specific applications.

Dr. Kline outlined the present state of development of standards for plastics suitable for building. The ASTM in cooperation with the Society of the Plastics Industry has recently organized some new subcommittees under Committee D-20 on Plastics to work on standards and specifications for such items as plastic pipe and reinforced plastics. The SPI has also sponsored investigations at the University of Michigan and Battelle Memorial Inst. to develop information on the properties of plastic pipe. Both the National Electrical Manufacturers Assn. and the ASTM have published voluminous standards and specifications for plastic materials useful to builders. Commercial standards for such items as polystyrene wall tile have been prepared by trade associations and published by the U. S. Department of Commerce. The military services have also contributed to development of standards by their early and effective work in preparation of specifications for plastics used by them.

The Plastics Section of the National

Bureau of Standards has been active in the development of test methods and standards for plastics both by the determination and publication of technical data relating to many types of plastics and by assigning personnel to work with other organizations on committees engaged in drafting standards for plastics.

Mr. Rarig spoke on some of the problems involving plastics and the building codes and regulations. He indicated that although there is a trend toward uniformity in building codes, they are administered by a large number of groups in states, cities, counties, etc., where the codes are subject to a variety of interpretations. Few building codes consider plastic materials at all, and in an effort to promote amendments to codes to permit and regulate the use of plastics, it was found that regulatory agencies would not approve legislation permitting only one type or class of plastic nor would they accept general legislation which would open the gates to a flood of nonstandardized, experimental products. The problem was to define the new field of plastics in meaningful, practical terms.

To define the subject, it was proposed that the current edition of "Technical Data on Plastics" published by the Manufacturing Chemists' Assn., Inc., be the "pharmacopoeia" for the plastics field and that a plastic material be defined for the purpose of building code legislation as being made wholly or principally from standardized plastics listed therein. Having defined the plastics, reference was then made to ASTM standard test procedures to classify the material into groups based on burning rate. Also standard methods for identification were proposed to insure that the specified material is supplied. Code proposals based on this approach to the problem of plastic regulations have been approved by the Buildings Officials Conference of America and the National Board of Fire Underwriters, and by such cities as Los Angeles, New York, and Milwaukee.

Mr. Rarig pointed out that in areas where performance standards are generally applicable such as for plumbing, insulation, sheathing, and structural members, the plastics industry's primary problem seems to be one of standards.

During the last session on the future uses of plastics in building, a feature was a round table participated in by two plastics experts and four architects. The moderator was Johan Bjorksten of Bjorksten Research Laboratories. The interesting speculations of the architects were partly supported and partly dampened by the more realistic but equally optimistic view of the plastics experts.

The Bookshelf

Cellular Concretes

R. C. Valore, Jr., *Am. Concrete Inst.*, 18263 W. McNichols Rd., Detroit, Mich., 44 pp., \$1

CONCRETE weighing from 10 to 100 lb per cu ft and having a homogeneous void or cell structure are termed "cellular concretes," a definition that does not ordinarily encompass lightweight aggregate concretes.

The degree in which important properties (that is, density, thermal conductivity, strength, dimensional stability, and moisture properties) of cellular concretes differ from those of better-known lightweight aggregate concretes has not been comprehensively reported in American literature. This new ACI publication summarizes from the literature of Europe, where these materials are well known, and from a study in progress at the National Bureau of Standards, the properties and methods of preparing cellular concretes of various types.

• • •

Magnetic Cooling

C. G. B. Garrett, *The Harvard University Press and John Wiley & Sons, Inc.*, New York, 110 pp., \$4.50

THIS most recent book on the subject of magnetic cooling gives a review of work done in England, The Netherlands, and the United States, particularly the progress in technique and theory within the last decade.

The author emphasizes the wide variety of different fields of knowledge with which this subject must concern itself as well as the possible applications of the magnetic cooling technique.

This text will provide stimulating reading for physical chemists as well as advanced students interested in the phenomena occurring at one of the extremes of accessible physical conditions.

Testing of Stainless Steel Weldments

Helmut Thielsch, *American Welding Soc.*, 33 W. 39th St., New York, N. Y., 26 pp., \$1

WELDING Research Council *Bulletin No. 18*, profusely illustrated, includes discussion of the following major inspection and testing procedures applied to stainless steel weldments: (1) visual inspection, (2) magnetic-particle inspection, (3) fluorescent-penetrant inspection, (4) dye-penetrant inspection, (5) radiographic inspection, (6) ultrasonic inspection, (7) mechanical testing, (8) corrosion testing, (9) removal of trepanned plugs or boat-shaped (saw-cut) specimens, (10) leak testing by means of hydrostatic methods, air pressure, chemical indicators or mass spectrometers, (11) etch testing for ferrite, carbides and sigma, and (12) restrained crack-sensitivity testing. One hundred and fifty references to published and unpublished information are included.

• • •

Ceramic, Paper, Rubber, Textile, Wood, and Other Products & Processes

Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C., \$1

THIS final book in the 1954 series of seven new Government publications containing abstracts or brief descriptions of Government-owned inventions lists 308 abstracts describing patented inventions applicable to the several fields included in the title.

The 308 listings in this book are classified as to industrial use under several groups to help readers quickly locate items of particular interest: ceramics; lapidary items; leather; paper; rubber; safety devices; textiles; tobacco; wood;

and miscellaneous products and processes.

In addition to the abstracts, this book includes the title and number of each patent, name of inventor, the Government agency administering the patent, and a list of the addresses of the field offices of the U. S. Department of Commerce and of the Small Business Administration which may be consulted for further information concerning the availability and use of any Government-owned inventions. The three Government agencies cooperating in making this technical information conveniently available are hopeful that American business will take full advantage of the facilities provided by these field offices by letter or personal visit.

• • •

Mechanical-Property Tests on Ceramic Bodies

Wright Air Development Center, 1952. 87 pp., OTS, U. S. Dept. of Commerce, Washington 25, D. C., \$2.

KNOWLEDGE of the mechanical behavior of ceramic bodies is an important prerequisite to the use of ceramics for aircraft construction materials, particularly for parts of gas turbines and jet engines. This report describes research aimed at defining strength properties by expressions that include the influence of each external factor. These factors included stress system, size, rate of stressing, temperature and porosity. Types of test included tension, compression, torsion, bend, and combined stress. In addition to describing the experimental work and picturing test equipment, the report reviews at length the various theories of strength for guidance in developing relationships among the strength properties of ceramics.

To ASTM Nonmembers: The Society welcomes inquiries on the "Advantages of Membership"

To the ASTM Committee on Membership
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Testing of Hydrometers,

Circular 555, NBS Government Printing Office, Washington 25, D. C., 10 pp., 10 cents

This Circular supersedes NBS Circular 477, *Testing of Hydrometers*. The Circular presents to manufacturers and users information regarding the design, construction, and calibration of hydrometers and specifies the Bureau's requirements for their certification.

The various scales that are commonly used for hydrometers are defined in this Circular, and recommendations are given for subdividing and marking them. These scales include density, specific gravity, degrees Baumé, degrees API, percentage by weight, percentage by volume, percentage of proof spirit, Brix, Balling, and some others. The relations between some of the arbitrary scales (for example, API) and specific gravity are stated.

The Circular outlines the procedure for testing hydrometers that are submitted to the Bureau and discusses the forms of certificates and reports issued as a result of these tests. Instructions and other helpful information about submitting hydrometers for test are given.

Research and Development of Metals and Alloys for Low Temperature Applications

Materials Advisory Board, National Research Council, 1954. 77 pp., available from OTS, U. S. Department of Commerce, Washington 25, D. C., \$2

This report of the Panel on Metals for Use at Low Temperatures gives conclusions and recommendations for improving the efficiency of military equipment operating at temperatures down to -80 deg. Basic problems of low temperature operation are discussed, including the brittle fracture of ferritic steels, the mechanism of deformation

and fracture, the development of improved welding techniques and non-destructive test methods, varying service-stress conditions, the economy and availability of raw materials, and the establishment of performance criteria. A 49-page appendix presents topical reports reviewing low temperature problems and properties of the principal metals and alloys. A list of additional information sources is included.

High Temperature Properties of Materials and Mechanics of Creep

PROCEEDINGS are now available on short courses held at The Pennsylvania State University during June, 1954.

The proceedings on the High-Temperature Properties of Materials course were prepared by C. Zener, B. J. Lazan, G. V. Smith and M. J. Manjoine, W. D. Manly and D. R. Miller.

The proceedings on the Mechanics of Creep short course were prepared by J. E. Dorn, G. R. Irwin, L. F. Coffin, F. R. Shanley and G. D. Lubahn and E. A. Davis.

For further information write Joseph Marin, Department of Engineering Mechanics, The Pennsylvania State University, State College, Pa.

Fire Hazards in the Metalworking Industries

IN RECENT years the metalworking industries have been beset by fire. Since 1942 large-loss fires in both heavy and light metalworking plants have increased 17 times. This is due in part to higher concentration of values in buildings, equipment, and products exposed to fire and to hazard-

ous new auxiliary processes and mixed occupancies.

These facts are brought out in a 57-page survey on fire hazards and safeguards for metalworking industries issued recently by the National Board of Fire Underwriters.

The survey points out that many new factors have entered the fire safety picture in recent years, but what is more important is the presence of old fire causes in a more pronounced form. These are large unprotected areas, and the use of woodwork and plastic materials in fabrication processes as well as the use of flammable liquids.

To receive a copy of this survey write to the National Board of Fire Underwriters, 85 John St., New York 38, N. Y. If you live in the Middle West, write to 222 West Adams St., Chicago 6, Ill., and if west of the Rockies, to 465 California St., San Francisco 4, Calif.

Low-Temperature Test Methods and Standards for Containers

Advisory Board on Quartermaster Research and Development, Committee on Packing, Packaging and Preservation, 126 pp., Quartermaster Food and Container Institute, 1819 West Pershing Rd., Chicago, Ill.

CONTAINS information on low-temperature testing and research facilities in both industry and Government laboratories. Also includes papers on the effects of low temperatures on containers and container materials.

Deterioration of Materials—Causes and Preventive Technique

G. A. Greathouse and C. J. Wessell, 835 pp., Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y., 1954, \$12.

THIS volume compiled from the contributions of 24 specialists brings together under one cover a comprehensive analysis of deterioration problems and a survey of techniques for increasing the useful service life of many commonly used materials. These include metals, wood, textiles, paper, and paints.

To ASTM Members: Your help is needed in maintaining that constant increase in ASTM Membership

To the ASTM Committee on Membership,
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Gentlemen:

Please send information on membership to the company or individual indicated below:

This company or individual is interested in the following subjects: indicate field of activity, that is, petroleum steels, non-ferrous, etc.

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PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

NOTE—These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.

At the Annual Meeting of The American Society of Mechanical Engineers in New York City in December a number of active ASTM members and those in responsible positions with ASTM company members were honored. **Henry B. Oatley**, for many years Vice-President of the Superheater Co.; currently Chairman of ASTM Committee A-1 on Steel, and for a number of years Chairman of the ASME Boiler Code Committee, was elected Honorary Member. **Abbott L. Penniman, Jr.**, Vice-President, Consolidated Gas Electric Light and Power Co. of Baltimore, who is interested in ASTM work, particularly Committee A-1, was tendered an ASME honorary membership. **George L. Sullivan**, Dean, College of Engineering, University of Santa Clara (Calif.) also was elected to honorary membership. **E. Burnley Powell**, elected a Fellow of ASME in 1952, and this year celebrating fifty years of continuous membership, received the ASME Medal, established in 1920, "for distinguished service in engineering and science." One of the most widely consulted engineers in the public utility field, Mr. Powell was associated for many years with Stone & Webster Engineering Corp. where he introduced economic systemization of operation and maintenance in electric generating plants for power and traction companies managed by his firm. **Dr. Walter A. Shewhart**, Bell Telephone Laboratories, Murray Hill, N. J., who was unable to be at the meeting, is to be tendered the Holley Medal which recognizes "some great and unique act of genius of engineering nature that has accomplished a great and timely public benefit." A leading authority on the application of statistical methods to quality control in industrial standardization, Dr. Shewhart has been interested in the ASTM activities in this field. **Dr. Walker I. Cisler**, President, The Detroit Edison Co., received the Westinghouse Award for "eminent achievement and distinguished service in the power field of mechanical engineering."

Incoming ASME Council Members introduced at the meeting included active ASTM members—**Harold C. R. Carlson**, President, The Carlson Co., New York City, authority on springs and testing instruments; and **Dr. Elmer O. Bergman**, Technical Adviser, C. F. Braun Co., Alhambra, Calif.

Another recent announcement from ASME indicates that **H. C. Boardman**, Director of Research, Chicago Bridge and Iron Co., is the new Chairman of the ASME Boiler Code Committee, replacing retiring Dr. Oatley; and **Dr. Bergman** has

been designated chairman of its important Subcommittee on Unfired Pressure Vessels. **J. D. Wilding**, serving as Acting Secretary of the Boiler Code Committee, replaces **J. H. Deppeler**, who has retired and is moving to Florida.

Robert H. Aborn, Assistant Director of U. S. Steel's Fundamental Research Laboratory, Kearny, N. J., since 1947, has been named Director. **D. S. Miller** has been named an Assistant Director. Messrs. Aborn and Miller both have served for many years on ASTM Committee E-4 on Metallography and numerous subgroups. Mr. Aborn is also a member of the Joint Committee on Definitions of Terms Relating to Heat Treatment of Metals, representing the American Society for Metals; and for some years served on the Joint ASTM-ASME Committee on Effect of Temperature on the Properties of Metals.

Gale L. Adams has retired as Manager, Laboratories, General Petroleum Corp., Los Angeles, Calif. He is succeeded by **R. A. Baker**.

H. W. Angell, formerly with the American Lumber and Treating Co., Chicago, Ill., is now on the staff of the Technical Dept., Koppers Co., Inc., Wood Preserving Div., Orrville, Ohio.

Kenneth H. Barnard recently retired as Technical Assistant to Manager, Textile Resin Dept., American Cyanamid Co., Bound Brook, N. J. Mr. and Mrs. Barnard are moving from Bound Brook to their permanent home at Barnstable, Mass. He will remain active as a consultant on textile finishing. In ASTM Mr. Barnard has been very active in Committee D-13 on Textile Materials, being a member of the Advisory and other subcommittees, and serving as secretary of Subcommittee A-10 on Non-Woven Fabrics.

Dr. Leslie C. Beard, Jr., Assistant Director, Socony-Vacuum Labs., Socony-Vacuum Oil Co., Inc., New York City, and immediate Past-President of ASTM, was honored at the annual meeting of the American Petroleum Institute in Chicago in November through the award of a "certificate of appreciation" in recognition of valued services rendered to the Institute's program of fundamental research. In ASTM, Dr. Beard has made important contributions for many years to the work of Committee D-2 on Petroleum Products and Lubricants, serving on the advisory and many other subgroups, and as chair-

man of numerous subcommittees. In administrative phases of the Society's work, in addition to his service on the Board of Directors and as President, he has been active in the New York District Council, serving as secretary for a two-year period.

J. J. Brennan recently retired as Supervisor of Testing Laboratory, Northern States Power Co., Minneapolis, Minn. He is succeeded by **F. P. Tierney**, who will represent the Company's ASTM sustaining membership.

Wallace R. Brode, Associate Director for Chemistry at National Bureau of Standards, Washington, D. C., has been re-elected Regional Director of the Fourth District of the American Chemical Society.

R. W. Callon, formerly Head, Analytical Div., Aluminium Laboratories, Ltd., Arvida, Canada, is now Staff Officer, Personnel Dept., Aluminum Company of Canada, Ltd., Montreal. Mr. Callon participates actively in the work of Committee E-2 on Emission Spectroscopy, serving on several subgroups and as chairman of Subcommittee VII on Aluminum, Magnesium, and Their Alloys.

J. M. Campbell, currently a Director of the Society, is now Technical Director of the Research Laboratories Division, General Motors Corp., Detroit, Mich.

George F. Comstock recently retired as Assistant Director of Research, Titanium Alloy Manufacturing Division of The National Lead Co., Niagara Falls, N. Y. For many years representative of the company membership in ASTM, Mr. Comstock had been very active in Committees A-1 on Steel, A-3 on Cast Iron, A-9 on Ferro-Alloys, and A-10 on Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys. He had served as Secretary of Committee A-9 from 1948 to 1954. Mr. and Mrs. Comstock are residing at 1251 Essex Road, Winter Park, Fla.

John H. Curtiss, formerly Senior Scientist, Institute of Mathematical Sciences, New York University, is now Executive Director, American Mathematical Society, Providence, R. I.

Donald O. Dockendorf is now Director of Research and Development, Dockendorf Research Foundation, Santa Barbara, Calif. He was previously associated with Resin Industries, Inc., in the same city.

C. E. Emmons, Los Angeles, Calif., is one of several recently named regional managers of The Texas Company. Mr. Emmons has been very active in the ASTM Southern California District Council.

(Continued on page 79)

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(Continued from page 76)

oil for many years, serving terms as Vice-Chairman and Chairman. He is currently serving as chairman of the Subcommittee on Finance of the General Committee on Arrangements for the Second ASTM Pacific Area National Meeting (September 16-22, 1956). He is a member of Section IV on Lubricating Grease Research Techniques of Technical Committee G on Lubricating Grease of ASTM Committee D-2 on Petroleum Products and Lubricants.

Alexander L. Feild, Associate Director of Research, Armco Steel Corp., Rustless Division, Baltimore, Md., was named 1954 Sauveur medalist. The medal, given by the American Society for Metals, recognizes achievements which have made a marked contribution to the basic knowledge of metals.

Lorin L. Ferrall has been elected Vice-President of Operations, Crucible Steel Co. of America, Pittsburgh, Pa.

Paul D. Foote, former Vice-President and Director of Research for Gulf Oil Corp., received the 1954 Pittsburgh Award of the American Chemical Society for outstanding contributions to the advancement of chemistry in the Pittsburgh area. The presentation, in the form of a bronze plaque, marked the fourth time Mr. Foote has been singled out for distinguished honor since 1951 when he received the Outstanding Achievement Gold Medal of the University of Minnesota. Two years later, Carnegie Institute of Technology gave him an honorary D.S. degree, and in 1953 he was chosen "Man of the Year" by Pittsburgh's Junior Chamber of Commerce.

Virgil E. Gunlock, Commissioner, City of Chicago, Department of Public Works, Bureau of Engineering, and Chairman of the Chicago Transit Board, has been nominated for Vice-President of the Central Region, National Society of Professional Engineers.

Carl W. Hedberg, formerly Vice-President of Research Corp., in charge of the Precipitation Division, has been elected President of Research-Cottrell, Inc., New York City, a wholly-owned subsidiary to operate the electrical precipitation business previously conducted by Research Corp.

The many friends and associates of **John C. Hostetter**, Consultant, Mississippi Glass Co. (permanent residence, Winter Park, Fla.) would expect that despite a couple of hard blows he would be cheerful and looking forward to getting out of the hospital. Some time ago his right leg was amputated above the knee; and in October the doctors found it necessary, because of additional circulatory trouble, to take off the left leg below the knee. For some weeks he has been in the Columbia Presbyterian Hospital in New York City and has had a number of visitors, including the ASTM Executive Secretary who saw him on December 2. As soon as feasible he will go to another institute in New York

for fitting of prosthetic devices, making his headquarters at the George Washington Hotel on 23rd St. On Columbus Day (during Pennsylvania Week) Dr. Hostetter was honored by his native city of Williamsport by designation as Pennsylvania Ambassador, a relative representing him at the presentation of an aluminum plaque with citation "... awarded to John C. Hostetter, noted scientist and industrialist who has risen to a place of leadership in the ceramics industry," signed by Governor Fine and leaders in the Pennsylvania and Williamsport civic offices. In ASTM, Dr. Hostetter has been extremely active—was a prime mover in the organization of Committee C-14 on Glass and Glass Products, serving as Chairman, 1942-1944. He was Chairman of the St. Louis District Council when he was President of Mississippi Glass Co., and has done much to advance the work of the Society.

Frank Jaros, formerly Vice-President, Kompolite Co., Inc., Brooklyn, N. Y., is now President, Allied Compositions Co., Inc., Long Island City.

Gus Kaufman has been named Manager of Operations, The Texas Co.'s Research and Technical Dept., New York City. He was formerly Assistant Manager. Mr. Kaufman has been very active in the work of Committee D-2 on Petroleum Products and Lubricants.

Paul E. Klopsteg, Director of Research, Northwestern University Technological Institute, recently retired with the rank of Professor Emeritus of Applied Science. He has been Associate Director of the National Science Foundation in Washington since 1951, and has served as adviser to Northwestern. For some years Professor Klopsteg was a member of Committee E-1 on Methods of Testing.

The many friends and former associates of **J. O. Leech**—for many years Assistant Metallurgical Engineer, Carnegie-Illinois Steel Corp., and extremely active in the work of Committee A-1 on Steel—will be interested to know that Mr. Leech was visited by President Mochel and Executive Secretary Painter when they were in Schenectady recently. "Ollie," who is a Past-Director and Honorary Member of the Society, is now 79 years old, and resides with Mrs. Leech and his son Bob and family on the Schenectady-Troy Road (2471), Schenectady 9, N. Y. While he has not been too well for a number of years, he is cheerful and alert, and he and the Society officers had a nice visit. Probably his outstanding service to ASTM and to the industry was his meticulous care in establishing nomenclature in the ASTM steel specifications, so that insofar as possible they meant exactly what was printed. He has been an outstanding authority on the nomenclature of iron and steel. His son Bob, formerly of the Watertown Arsenal, has been for some years in the General Electric Research Laboratories, and currently is responsible for facilities in the new GE Metals Pilot Research Laboratory under construction.

John M. Neff, until recently Assistant Manager, has been named Manager of the Ceramics and Minerals Research Dept., Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.

Malcolm M. Renfrew has been appointed Director of Research and Development, Spencer Kellogg and Sons, Inc., Buffalo, N. Y. For the past five years Dr. Renfrew has been associated with General Mills, Inc., Minneapolis, Minn., and prior to that he spent 11 years with E. I. du Pont de Nemours & Co.

Frank H. Riddle, Vice-President, Champion Spark Plug Co., Detroit, Mich., has been named the 1955 recipient of the Albert Victor Bleining Award, given annually by the Pittsburgh Section of the American Ceramic Society for distinguished achievement in the field of ceramics. The medal and scroll representing the award will be presented at the Bleining Award Dinner to be held in March at the Hotel Schenley, Pittsburgh. Mr. Riddle was associated with Mr. Bleining 1916-1919, serving as his assistant in the Clay Products Division of the National Bureau of Standards.

Musser F. Rupp, Sr., for many years Chief Testing Engineer, Reynolds Alloys Co., Sheffield, Ala., has been promoted to Supervisor of Metallurgical and Engineering Research and Development, at the Metallurgical Research Labs., Reynolds Metals Co., Richmond, Va. **James H. Dempsey**, who has been training under Mr. Rupp and is now Testing Supervisor for Reynolds Alloys, at Sheffield, has qualified as a member of the Society, on recommendation of Mr. Rupp, who has been affiliated for many years, and active in technical committee work.

Marvin L. Steinbuch has been appointed Chief Metallurgist and Research Director, The Lunkenheimer Co., Cincinnati, Ohio, succeeding **John W. Bolton**, recently retired. Mr. Steinbuch is a member of ASTM Committee B-5 on Copper and Copper Alloys, serving as secretary of Subcommittee F-1 on Castings, and Ingots for Remelting. He also serves on Committee D-20 on Plastics.

Breckinridge K. Tremaine, formerly associated with E. I. du Pont de Nemours & Co., has joined Rhodia, Inc., New York City, as Technical Director of its Industrial "Alamask" Reodorant Division. Since April of this year he has been on loan to Rhodia as acting technical director.

E. J. E. Van Dyck, until recently with Madagascar Graphite and Mica Co., New York City, is now Sales Manager, Cheney Brothers, in the same city.

William B. Wallis, President, Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa., has been elected President of the Foundry Equipment Mfrs. Assn.

Clarence A. Weltman has been named Executive Vice-President and Technical

(Continued on page 80)

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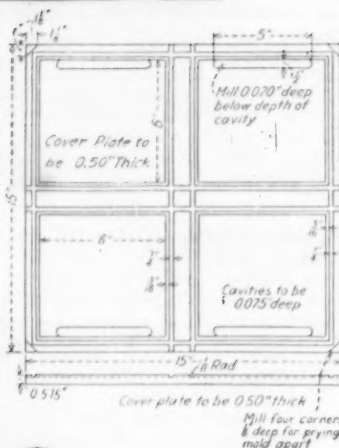
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(Continued from page 79)

Director, Alox Corp., Niagara Falls, N. Y. He was formerly Chief Chemist.

D. B. Wendling has been appointed Materials Engineer, Birmingham Slag Co. Until recently he was Assistant to Sales Manager.

G. Stafford Whitby, head of the University of Akron's Department of Rubber Research since its inception in 1942, recently retired. He had been named Professor Emeritus of Rubber Chemistry in 1952, but remained as Director of Rubber Research. He will continue to be available as a consultant in the department. Outstanding in the rubber chemistry field, Dr. Whitby was acclaimed 1954 winner of the ACS Charles Goodyear Medal, highest award in the field. In ASTM, Dr. Whitby has been active in Committee D-11 on Rubber and Rubber-Like Materials, and certain subgroups.

Frank H. Yurasko has been appointed an Assistant Director in the Engineering Mechanical Div., Standard Oil Development Co., Linden, N. J. Mr. Yurasko serves on ASTM Committee E-7 on Non-Destructive Testing.

Paul Zeigler, Director of Kaiser Aluminum & Chemical Corp.'s Dept. of Metallurgical Research, Spokane, Wash., has moved to company headquarters in Oak-

land, Calif. D. W. Smith, Associate Director, will assume the duties of laboratory manager in addition to those of his present post. S. E. Maddigan, Head of the Mechanical Evaluation Section, has been made Assistant Director of the department.

ASTM Well Represented in New Officers of the ACIL

New officers for 1955 have been announced by the American Council of Independent Laboratories, Inc. Elected President was Lewis F. Herron of Cleveland, Ohio, President of the James H. Herron Co. Other officers are Vice-President, Dr. Alvin C. Purdy of New York City, President of Bull & Roberts, Inc.; Secretary, Dr. Roger W. Truesdail of Los Angeles, President of Truesdail Laboratories, Inc.; and Treasurer, F. H. Wright of New York, Vice-President of Lucius Pitkin, Inc. The Executive Committee is composed of the elected officers, the immediate Past-President of the Council, Fred B. Porter of Fort Worth, President of Southwestern Laboratories; W. D.

Langtry of Chicago, President of Commercial Testing and Engineering Co., C. A. Lashbrook of Oklahoma City, President of Oklahoma Testing Laboratories; and Herbert D. Imrie of San Francisco, President of Abbot A. Hanks, Inc.

Of the above group, ASTM membership is held by the James H. Herron Co.; Dr. Purdy; Lucius Pitkin, Inc.; Mr. Porter; Commercial Testing and Engineering Co.; Oklahoma Testing Laboratories; and Abbot A. Hanks, Inc.

The American Council of Independent Laboratories, Inc. (formerly the American Council of Commercial Laboratories) is the professional association of independent scientific laboratories. There are 65 member laboratories with 66 branches located in the chief metropolitan centers of the country. Serving American industry, these laboratories aid in the development and improvement of new products and processes, test for control of manufacture, for quality of materials, and for consumer acceptability; and inspect the finished commodities for compliance with procurement specifications, quality and serviceability. Membership is through careful screening. The average length of membership is over 40 years.

HYDRAULICS ENGINEER

Nationally-known Chicago manufacturer requires man, 24-35, to design and test hydraulic components and adaptations. Engineering degree preferred, but not required. Broad knowledge of hydraulics theory, design, and schematics necessary, as well as 3-5 years in hydraulic testing and/or manufacturing. Real opportunity for qualified man. Write in confidence resume of education, experience, and salary requirements to Box 51, ASTM BULLETIN, 1916 Race St., Phila. 3, Pa.

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LIGHT METALS and
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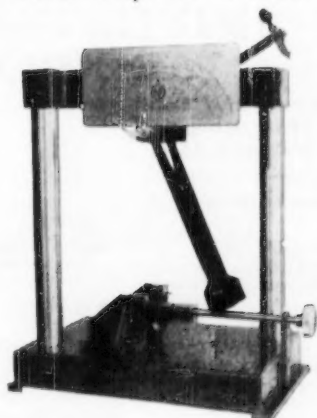
* Combined Izod and Charpy.

* Large, open-working-clearance design, with wide linear scales accurately calibrated.

* Two capacity combinations are available:

Model TM 52004;
3 ranges, 30 foot-pounds maximum capacity.

Model TM 52010;
3 ranges, 10 foot-pounds maximum.



Height—36 in.
Width—28 in.

Depth—16 in.
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Mass is properly concentrated close to the impact point. Hammers are integral with bits, have no screwed-on ballast weights or adjustable parts.

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Testing Machine Division

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and
reproducibility
achieved with
new modulated
temperature
control.

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A constant volume of air at a controlled temperature in the heavily insulated cabinet, maintains uniform predetermined specimen temperatures regardless of variations in room conditions.

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All automatic controls including complete voltage controls are located on the front panel of the Weather-Ometer directly above the door of the test chamber.

Both horizontal and vertical testing is available. Shallow containers are used for semi-liquid materials and vertical panels for solid materials.

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Complete technical information on the DMC model and other Weather-Ometers is contained in the new Weather-Ometer catalog. A copy will be mailed on request.

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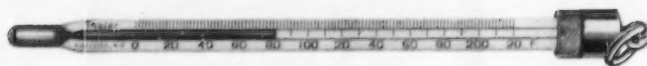


Handy Pocket Thermometers make your testing easy

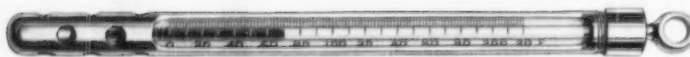
They're not only handy to carry, but easy to read too—at close range and with both eyes, thanks to BINOC* tubing, the optically-correct thermometer tubing. Provides a wide angle of vision and high magnification . . . the column is easily visible (red liquid is especially recommended where

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*Reg. U. S. Pat. Off.

TAYLOR INSTRUMENTS MEAN ACCURACY FIRST

NEW MEMBERS....

The following 18 members were elected from November 9 to November 29, 1954, making the total membership 7762 Welcome to ASTM

Note—Names are arranged alphabetically—company members first, then individuals

CHICAGO DISTRICT

Davis, Donald F., Chief Metallurgist, Central Steel and Wire Co., 3000 W. Fifty-first, Box 5310 A, Chicago 80, Ill.
Shrewsbury, G. R., Product Engineer, Reliable Electric Co., 3145 Carroll Ave., Chicago 12, Ill.

DETROIT DISTRICT

Spooner, Norman F., Metallurgical Engineer, Hoskins Manufacturing Co., 4445 Lawton Ave., Detroit 8, Mich.

NEW YORK DISTRICT

Cummings, H. N., Engineer, Technical Section, Curtis-Wright Corp., Propeller Div., Caldwell, N. J. For mail: 695 Grove St., Upper Montclair, N. J.
Korbelak, Alexander, Sales Manager, Sel-Rex Precious Metals, Inc., 229 Main St., Belleville 9, N. J.

NORTHERN CALIFORNIA DISTRICT
United Nations Korean Reconstruction Agency, Mining Division, APO 59, c/o Postmaster, San Francisco, Calif.

OHIO VALLEY DISTRICT

Westinghouse Electric Corp., W. H. Metcalf, Supervisor, Chemical & Metallurgical Laboratory, 300 Phillipi Rd., Columbus, Ohio.

PHILADELPHIA DISTRICT

Hoeganaes Sponge Iron Corp., Lennart Forss, Laboratory Manager, Riverton, N. J.

PITTSBURGH DISTRICT

Coros, John P., Plating Superintendent, Standard Steel Spring Div., Rockwell Spring and Axle Co., Coraopolis, Pa.

SOUTHERN CALIFORNIA DISTRICT

Bettencourt, Victor S., Manager, Specifications and Standards, Western Div., Collins Radio Co., 2760 W. Olive Ave., Burbank, Calif. For mail: 14436 Osborne St., Van Nuys, Calif.
Martin, Robert W., Project Engineer, Standard Electronic Manufacturing Co., 11861 Teale St., Culver City, Calif. For mail: 5531 Etiwanda Ave., Tarzana, Calif. [J]*

SOUTHWEST DISTRICT

Standard Testing and Engineering Co., F. Eugene Alban, President, Box 6157, Oklahoma City, Okla.
Smith, Daniel F., Owner & General Manager, Daniel F. Smith Laboratories, 3607 Fannin St., Houston 4, Tex. For mail: Box 2477, Houston 1, Tex.

Smith, George G., Vice-President, Texas Construction Material Co., Box 78, Houston 1, Tex.

WESTERN NEW YORK-ONTARIO DISTRICT

Sachs, George, Director, Metallurgical Research Laboratories, Syracuse University Research Institute, Building D-6, Colledge Campus, Syracuse 10, N. Y.

OTHER THAN U. S. POSSESSIONS

Contovounesios, Basil Evan, Director, B. E. Contovounesios, Imports-Exports, 6, St. Constantinou St., Athens, Greece. For mail: 29, Distomou St., Athens, Greece.
Stevenson, R. D., City Engineer, The Council of the City of Sydney, Town Hall, Sydney, N.S.W., Australia.
Woodruff, C. M., Quality Control Engineer, American Nepheline Limited, Lakefield, Ont., Canada.

* J denotes Junior member.

Mullen Testers

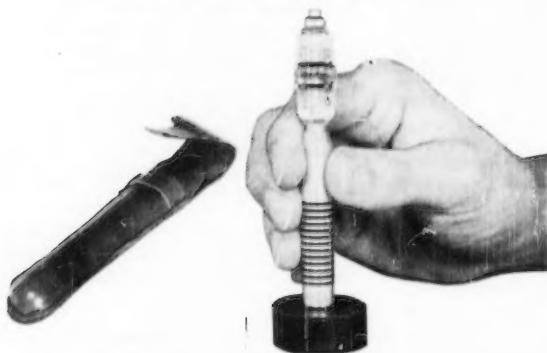
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"SPECTRONIC 20"

SPECTROPHOTOMETER

COLORIMETER

Diffraction Grating Type



- Range 375 mμ in the violet to 950 mμ in infrared.
- Band width 20 mμ.
- Direct reading in transmission or optical density.
- Plug-in printed electronic circuit.

"SPECTRONIC 20," Bausch & Lomb. A wide range, compact, versatile, direct reading instrument, with high degree of accuracy, simple to operate, and at remarkably low price.

Effective band width 20 mμ. Provides monochromatic light in range from 375 mμ in the violet to 950 mμ in infrared. Wavelength dial graduated at intervals of 5 mμ.

Consisting of diffraction grating monochromator with pre-focused light source and fixed slits; phototubes; electronic amplification system and built in transformer for a.c. operation; and meter for direct indication of transmission and optical density. Three controls adjust the wave length setting, light intensity and zero, respectively. Results are reproducible within 0.5%.

9084-K. "Spectronic 20," B. & L., with blue and red-sensitive phototubes and filter; for routine colorimetric determinations. For 115 volts, 60 cyc., a.c.230.00

9085-M. Special External Voltage Stabilizing Transformer, recommended for use with above for stable operation....30.00

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Simple and rapid for routine production control with one switch finger tip operation.

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Model 49RC fitted with General Purpose Grips for strips one inch wide illustrated at right.



Self-contained ELECTRO-HYDRAULIC drive provides smooth, even, shockless loading.

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Ranges provided in one instrument literally can be from grams to tons.

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121

DEATHS...

Col. James Ten-Broek Bowles, Secretary, Technologist, Crown Central Petroleum Corp., Baltimore, Md. (November 28, 1954). Member of the Society and of ASTM Committee D-C on Petroleum Products and Lubricants since 1921. Colonel Bowles graduated from the University of Michigan in 1907, after which he did research work at the University of Wisconsin and the University of Kansas. He was a member of the Panama Canal Commission during the construction of the canal. He later served as a sanitary expert with the Army during the occupation of Vera Cruz just prior to World War I. During World War I he served as a Lieutenant-Colonel in the Chemical Warfare Service with the AEF in France. His title of Colonel stemmed from this interlude. In 1921 he joined Tide Water Oil Co., Bayonne, N. J., as Technologist. In 1925 he joined Crown Central Petroleum Corp., and later became Secretary and Chief Technologist of that company. He was a "charter member" of the Coordinating Fuel Research Committee of the Coordinating Research Council, Inc., organized in 1921. In addition to his ASTM and Committee D-2 affiliation, he was a member of the American Petroleum Inst. and several API committees, the American Chemical Society, the Society of Automotive Engineers, and The Institute of Petroleum (London). Colonel Bowles

had retired from active duty with his company early in 1954.

Robert Burns, Production Manager, Fabric Finishing, Celanese Corp. of America, New York City (April 7, 1954). Member of the Society since 1951, and representative of his company since 1947 on Committee D-13 on Textile Materials and several of its subcommittees.

Walter E. Corbett, Owner, Corbett Concrete Pipe Co., Milford, Mass. (November 5, 1954). Member of Society since 1930, and of Committee C-13 on Concrete Pipe and several of its subgroups since 1936, serving at the time of his death as Chairman of Subcommittee III—Steering Committee on Long Range Program. A graduate of the Massachusetts Institute of Technology, Mr. Corbett served as an Engineering officer in France during World War I. He came into the pipe industry as an employee of the Lock Joint Pipe Co., serving in many capacities, and when he left the Lock Joint Co. in 1930 to form his own business he had been superintendent in charge of many large concrete pipe projects in a wide area of the country. In addition to ownership of his concrete pipe producing plant, he was a member of the firm of Eastman and Corbett, Civil Engineers. Recognized as a leader in the industry, he was a Director of the American Concrete Pipe Assn. for two terms and its President in 1943. He was affiliated with many technical and professional organiza-

tions, and active also in numerous civic groups.

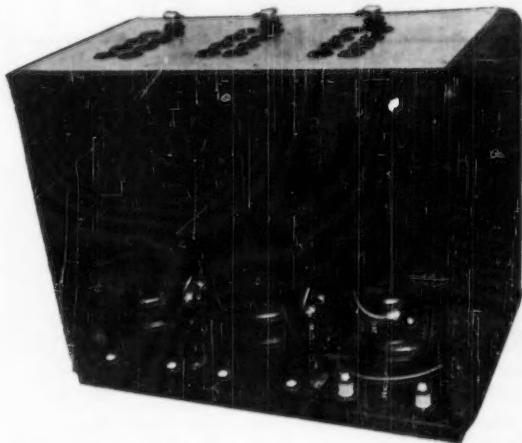
Jacob Jay, New York City, Department of Purchase, New York City. Representative of the NYC Department of Purchase since 1943 on Committee D-11 on Rubber and Rubber-Like Materials, and its Subcommittees XI on Chemical Analysis of Rubber Products and XV on Life Tests for Rubber Products. He also had served for the past 11 years on ASA Section Committee L-3 on Specifications for Rubber-Lined Fire Hose.

G. W. John, Sr., Petoskey Portland Cement Co., Petoskey, Mich. Representative of his company since 1949 on Committee C-1 on Cement.

Morris Wooton Loving, Consulting Engineer and Concrete Technologist, Glenview, Ill. (December 3, 1954). Born in Virginia in 1891, Mr. Loving (known as "Mike" to his business and committee associates) graduated from the Virginia Polytechnic Inst. He served in World War I as a Captain of Engineers in France. In 1919 he entered the employ of the Portland Cement Assn., severing that connection in 1945 to engage in private consulting practice. In 1922 he became a member of ASTM, serving as Secretary of Committee C-13 on Concrete Pipe from 1932 to 1946, as a member of Committee C-4 on Drain Tile from 1929 to 1932, and as a

(Continued on page 85)

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THREE TEMPERATURES ... THREE HERMETIC REFRIGERATION UNITS**



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World's Largest Manufacturers of Cloud and Pour Test Equipment

(Continued from page 84)

member of Committee C-6 on Hydrated Lime from 1923 to 1946. He was a leader in the development of the ASTM concrete sewer, culvert, and irrigation pipe specifications. His book "Concrete Pipe Lines" was for many years the leading authoritative source book on concrete pipe. He served as Secretary of the American Concrete Pipe Assn. from 1926 to 1945.

M. C. Madsen, Chief Engineer, Northern Natural Gas Co., Omaha, Nebr. (September 4, 1954). Representative of company membership in the Society.

John J. Regan, Owner, Philadelphia Steel & Iron Co., Conshohocken, Pa. (November 20, 1954). Company membership since 1926.

Harry E. Rowell, Metallurgist, Columbia Steel and Shafting Co., Pittsburgh, Pa. (August 25, 1954). Representative of company membership since 1951, also representative of his company on Committee A-1 on Steel and its Subcommittee XV on Bar Steels.

Alvah R. Small, retired Vice-Chairman of Underwriters' Laboratories, died October 8, 1954, at his home in Pompano, Fla., at the age of 71. A graduate of the University of Maine, Mr. Small had joined the staff of Underwriters' Laboratories in Chicago in 1906 as Assistant Electrical Engineer. In 1916 he became Vice-President; in 1924 he was transferred to the Laboratories' office in New York; and in 1935 he was elected President and transferred to the main office and testing station in Chicago. In June of 1948 he relinquished active control of the Laboratories' work and was made Vice-Chairman of the Board of Trustees. Although a Past-President of the National Fire Protection Assn. and active in many committees of the NFPA, he probably was more widely known as Chairman of the NFPA Electrical Committee. He also was on the Board of Directors and many committees of the American Standards Assn., Building Officials Conference, International Association of Electrical Inspectors, and the American Institute of Electrical Engineers (Fellow). In ASTM he was active from 1924 to 1952 on several of the sectional and technical committees, including former Committee C-10 on Hollow Masonry Building Units.

Reinforced Plastics Conference of SPI on West Coast

THE Society of the Plastics Industry has announced that the Reinforced Plastics Division will hold a conference at the Statler Hotel in Los Angeles on February 8, 9, and 10, 1955. This will be the first time that a conference of a national division of SPI has ever been held on the West Coast.

Reinforced plastics have attracted widespread interest on the Coast because of increasing use particularly by the aircraft industry. There are applications also in fields of building, transportation, containers, housings for machinery, storage tanks, and various uses requiring corrosion resistance.

ASTM activity in this field is under Subcommittee XVIII on Reinforced Plastics of Committee D-20 on Plastics. ASTM Committee C-19 on Structural Sandwich Constructions also has an interest.

NEWS NOTES ON Laboratory Supplies and Testing Equipment

Please mention ASTM BULLETIN when writing to suppliers

Note—This information is based on literature and statements from apparatus manufacturers and laboratory supply houses

INSTRUMENT NOTES

X-Ray Unit—A new lightweight 160-kv peak portable X-ray unit for industrial radiography is now available capable of X-raying 2 in. of steel.

Holger Andreassen, Inc., 703 Market St., San Francisco 3, Calif.

The Fracton—A new instrument for fast, accurate analysis of light hydrocarbon gases by adsorption fractionation.

Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.

Packaged Forge Gages—These precision instruments for horizontal and vertical measurement have been redesigned and improved so that every gage may be used in any and all positions from pull-end down to push-end. This improvement is accomplished by means of the knurled top with which the pointer can be adjusted to compensate for the variations in tare caused by the different positions in which the gage is used.

John Chatillon & Sons, 85-93 Cliff St., New York 38, N. Y.

Gaskets—An extensive line of Teflon O-Rings claims complete resistance to chemical attack, resistance to high temperatures, and extremely low coefficient of friction, and complete resistance to contamination of taste, odor, or coloring of foods, drugs, or high purity chemicals.

Chicago Gasket Co., 1271 W. North Ave., Chicago 22, Ill.

Displacement Indicator for Differential Transformer Transducers—Force, displacement, pressure, stress, strain, flow, weight, size, or any other mechanical quantity that can be measured by means of differential transformer transducers, can be indicated, recorded, or used for automatic alarm or control purposes using the new Model 304 Displacement Indicator.

Daytronic Corp., 216 S. Main St., Dayton 2, Ohio.

Load Transducers—Static or dynamic values of weight, force, compressive stress, or tensile stress are accurately transmitted by a new series of transducers now available in ranges from 500 to 50,000 lb.

Daytronic Corp., 216 S. Main St., Dayton 2, Ohio.

Adaptor for Pressure Pickups—A new, water-cooled adaptor for standard pressure pickups has been developed for pressure measurements at temperatures up to 4000 F.

Dynamic Instrument Co., Inc., 28 Carleton St., Cambridge, Mass.

Magnetic Tape Transport Unit—Designed for use with most digital computer and data processing systems, this unit

has a capacity of 2400 ft of $\frac{1}{4}$ or $\frac{3}{8}$ -in. magnetic tape which is moved at optional speeds of 30, 40, 50, 60, or 75 in. per sec by two constant-speed capstan motors.

ElectroData Corp., 717 N. Lake Ave., Pasadena 6, Calif.

Z-6 Diagram—A new instrument that instantaneously and accurately plots, by means of a light spot, complex impedances and admittances directly on a chart.

Instrument Div., Federal Telephone and Radio Co., Clifton, N. J.

Tweezer-Weld Gun—Capable of welding materials from 0.003 in. to the combined thickness of 0.074 in., this aluminum unit (2½ lb) will develop electrode pressures from 1 to about 50 lb with a light hand-squeeze pressure.

Federal Tool Engineering Co., Cedar Grove, N. J.

Color Control—This improved instrument for measuring color in "white" oils, naphthas, melted waxes, and gasolines introduces a revolving turret head for color comparison disks, eliminating the awkward time-consuming one-at-a-time changes of color disks necessary in older models.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Square Support Stand—A new square (9 by 9 in.) porcelain support stand, like the popular rectangular unit for double-buret titrations, is an ideal background for viewing that first fleeting change in an indicator. In addition, this new square unit offers the user ample space from aluminum support rod to front, for convenient single titrations.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Isotope Analyzer—An isotope analyzer designed to perform rapid and accurate qualitative and quantitative analysis of isotope mixtures containing beta-emitting components. The technique is based on the absorption and scattering of beta rays in materials of high atomic numbers.

Forro Scientific Co., 833 Lincoln St., Evanston, Ill.

Mercury-Thallium Thermometers—A eutectic mixture of mercury and thallium can be used for temperature measurement below the freezing point of mercury; calibration is not affected by long or repeated use, or by sudden transition in temperature.

H-B Instrument Co., American and Bristol St., Philadelphia 40, Pa.

Stainless Steel Pump—These pumps, formed hydraulically throughout, rather than cast, and mirror polished to avoid turbulence, with seals and gaskets of Teflon, are suitable for corrosive, food, and chemical applications.

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Electronic Micrometer—An electronic micrometer capable of controlling automatically a grinding machine's cycle and guaranteeing tolerances as low as 0.00015 in.

Industrial Gauges Corp., Englewood, N. J.

Cable Harness Checking—A rugged, compact instrument designed for complete testing of cable harnesses for continuity measurements, insulation resistance, and dielectric strength has been announced.

Industrial Instruments, Inc., 89 Commerce Rd., Cedar Grove, N. J.

Metal Treating—A compact 25 lb per hr controlled atmosphere heat-treating unit has been designed especially for laboratory and research work for temperatures up to 2000 F. It is equipped with an 8 by 14 by 8-in. hearth, electric radiant-type heating tubes, and a sealed quench or cooling chamber.

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Portable Water Bath Cooler—Temperatures can be controlled within the accuracy of the thermoregulator in a range from 0 F to ambient. A thermoregulator can be plugged into a convenient outlet in the top of the cabinet. The small size (22½ by 14 by 14 in.) of the metal cabinet, which is mounted on casters, makes it easy to connect the cooler at the spot where it is needed. It weighs less than 100 lb.

Arthur S. LaPine & Co., 6001 S. Knox Ave., Chicago 29, Ill.

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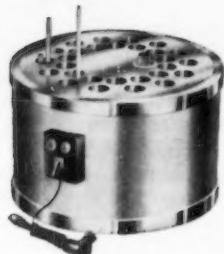
Viscosimeter Bath—Recommended for use in accordance with ASTM Method D 445, the Sargent Viscosimeter Bath provides reliable temperature control from a few degrees above temperature of the cooling coil to 212 F. The design of the bath produces an accuracy of ± 0.02 F.

Dept. ASTM, Advertising Div. of E. H. Sargent & Co., 4647 W. Foster Ave., Chicago 30, Ill.

(Continued on page 87)

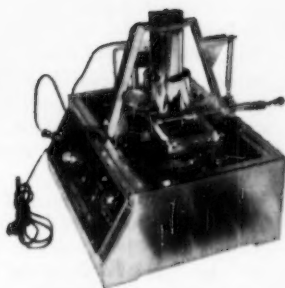
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Tests in conformance with ASTM Specifications for rubber and plastics, D865-53T and D572-53T.



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ORR L-5

Tests in conformance with ASTM Specification for rubber and plastics D412-52.



MODEL J

Tests in conformance with ASTM Specification for textiles and plastics D76-53.

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Descriptive literature sent upon request

SCOTT TESTERS, INC. 120 BLACKSTONE ST., PROVIDENCE, R. I.

(Continued from page 86)

Temperature Control for Ultracentrifuge Rotors—New temperature-control and measurement system makes possible the continuous indication and automatic control of temperature of operating ultracentrifuge rotors to better than 0.1 C.

Specialized Instruments Corp., 6620 O'Neill Ave., Belmont, Calif.

Oil Mate—A new oiling device that looks like an automatic pencil and delivers a drop of oil where it's wanted, when it's wanted, at the touch of a finger.

E. S. Tubin, 3908 Cohasset, Burbank, Calif.

Electromagnet—A new laboratory electromagnet embodying the most convenient features for varying magnetic field configurations was announced recently. The manufacturers envision widespread applications in general laboratory needs where the experimental conditions require precise magnetic field.

Special Products Div., Varian Associates, 611 Hansen Way, Palo Alto, Calif.

Frequency Meter—Primary purpose of this lightweight, portable instrument is to provide a rapid, accurate, and convenient frequency check of 400 cps generators; single or multiple-phase circuits may be tested.

The Winslow Co., Inc., 9 Liberty St., Newark, N. J.

CATALOGS AND LITERATURE

Stress-Strain Recorders—Stress-strain recorders and strain followers for use on Baldwin and other testing machines are presented in a new 28-page illustrated bulletin, No. 4215.

Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

Pulse Transformers—A new sheet, T-36A, describing Berkshire plug-in type pulse transformers is now available.

Berkshire Laboratories, 652 Beaver Pond Rd., Lincoln, Mass.

Temperature Control—A simple, unique method for straight-line temperature control throughout entire oven range is described in an eight-page, two-color brochure, "The Power-O-Matic Story."

Blue M Electric Co., 138th and Chatham St., Blue Island, Ill.

Digital Instruments—A new four-page brochure illustrates and describes fundamental facts covering a series of five related digital instruments for automatic counting, recording, and control.

Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

Pulse Testing—This six-page folder was prepared to acquaint engineers with three precision pulse generators made as part of a line of unitized pulse control equipment. The 8½ by 11-in. brochure is three-hole punched and can be conveniently filed in a loose leaf binder.

Burroughs Corp., Electronic Instruments Div., 1209 Vine St., Philadelphia 7, Pa.

Corrosion Control—A new 28-page catalog fully illustrated with photographs of parts and applications, contains corrosion resistance tables, charts, field reports from users, detailed test results and similar engineering information, covering many types of stainless alloys.

The Carpenter Steel Co., Alloy Tube Div., Union, N. J.

Etched Circuits—Techniques for the production of etched circuits and name plates utilizing Kodak Photo Resist, a new high-speed light-sensitive plastic coating, are described in the leaflet, *Etched Circuits and Name Plates With Kodak Photo Resist*.

Graphic Arts Sales Div., Eastman Kodak Co., Rochester 4, N. Y.

Laboratory Stirrers—Distinguished by a rheostat speed control, this model provides continuous light duty stirring from 100 to 1500 rpm under load. Up to 5 gal of aqueous solutions may be mixed vigorously with this laboratory stirrer. Complete details in Bulletin 440 X-54.

Eberbach Corp., Ann Arbor, Mich.

Portable Viscometer—The eight-page Bulletin IN.125 gives details of how the Ferranti Portable Viscometer can be used for a precise and direct indication of the viscosity of oils or many by-products.

Ferranti Ltd., Hollinwood, Lancashire, England.

(Continued on page 91)

Which Oscillator for You...

BFO or RC?

Three decades ago, G-R was the first to make the Beat-Frequency Oscillator widely available for use by the engineering profession. The basic RC Oscillator patent is also held, with 34 claims, by the General Radio Company. Today, G-R manufactures both Resistance-Capacitance Oscillators and Beat-Frequency Oscillators . . . two RC instruments and four BFO's, each intended for reliable service in one or more particular areas of application.

You can see we're not partial to either design. It does seem though, that the rapid acceptance of the RC generator over the last decade has led many to overlook the merits of the Beat-Frequency Oscillator. We feel it's high time to review the many basic advantages of this general-purpose signal source.

ADVANTAGES OF THE BEAT-FREQUENCY OSCILLATOR

Rapid Coverage — one complete turn of the dial, adjusts frequency over the entire range; this very useful feature permits rapid frequency-response investigations on all types of equipment — because the RC oscillator does not provide sufficient frequency overlap when switching from band to band, measurements at dial extremes can be very inconvenient and time consuming.

Constant Output Level Over Entire Range — an extremely important BFO characteristic which greatly facilitates frequency-response testing, eliminating need for constant adjustments — output level is not subject to discontinuities resulting from band switching as necessary with the RC oscillator.

Good Stability — the internal BFO fixed and variable oscillators are similar in construction so that temperature changes and supply voltage variations affect both sections by the same amount and tend to cancel — at 1 kc, typical drift of the BFO from cold start is less than 10 cps; this is easily corrected with a simple zero adjustment so this potential error is reduced to essentially zero — a good RCO has about the same drift but no control for correction.

Distortion Is Low — BFO waveform can be made almost entirely dependent on the waveform of its fixed-frequency source, which is easily kept free from distortion — representative distortion figures at 1000 cycles are 0.5% for the BFO, 1% for the RCO.

Long Term Calibration — accuracy of calibration of BFO depends upon the long-term stability of inductors rather than of resistors and is therefore inherently more reliable — the BFO can also take advantage of the inherent stability resulting from a low L to C ratio.

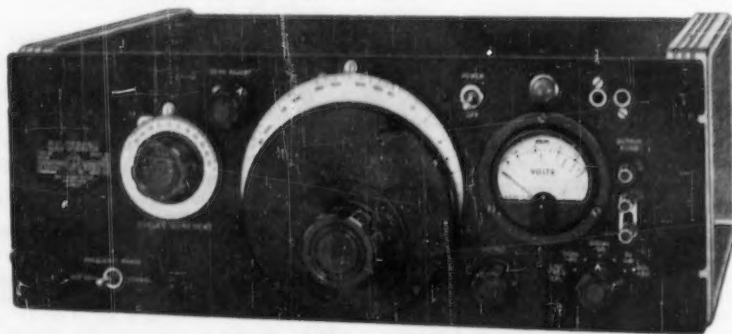
Logarithmic Frequency Control — the BFO has an outstanding advantage for audio-frequency testing; its frequency dial can be calibrated logarithmically over several decades — in the case of the G-R Type 1304-B, the dial drive can be connected directly to a recorder for the automatic recording of frequency response over a range of 20 to 20,000 cps without range switching. The RC oscillator usually requires three bands to cover this range.

Much has been made of the low-frequency limitations of the Beat-Frequency Oscillator where the RC circuits are definitely superior. But, in fairness, it should be said that a similar problem exists with the RCO since the tuning capacitor must operate above chassis potential, which may cause "lock in" at power-line frequencies and multiples thereof.

The Type 1304-B

Beat-Frequency Oscillator . . .

a basic laboratory tool. Frequency range from 20 to 40,000 cps — frequency-increment dial permits close adjustments of frequency, one cycle at a time — drift from cold start is less than 7 cps in the first hour, is essentially complete in two hours — distortion is minimum, less than 0.25% from 100 to 10,000 cycles, 0.5% at 50 cycles, and no more than 1% above 10 kc — meter and calibrated output attenuator included. . . . Price: \$555



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Sargent **Constant** **Temperature Bath**

The 0.01° C. Sargent Constant Temperature Water Bath, which is employed in many laboratories throughout the world where a precise, reliable thermostat is required, is now being supplied with an improved relay unit and heating system. The central heating and circulating unit of the bath is now equipped with three cylindrical heating elements rated at 200, 300 and 400 watts respectively. The 200 watt heater is controlled by the No. 81835 mercurial thermoregulator through a thyatron tube and saturable core reactor in the relay unit. (The use of a saturable core reactor obviates the difficulties commonly encountered with mechanical relaying systems such as pitted contacts, broken moving parts and freezing.) By means of a control mounted on the panel of the relay the output of this heater can be varied from the full 200 watts to approximately 60 watts, thus permitting such adjustment of the heater output that positive overshooting of the regulatory temperature is minimized. With the improved relay system this bath can be adjusted to a precision of $\pm 0.005^\circ \text{C.}$ when operating in the vicinity of 25°C.

In addition, the relay unit is equipped with a master switch, a switch for each heater and a pilot light to indicate that the circuit to the 200 watt heater is closed.

Maximum power consumption 1100 watts.

S-84805 WATER BATH—Constant Temperature, 0.01°C. , Sargent. Complete with Pyrex jar, 16 inches in diameter and 10 inches in height; central heating and circulating unit; constant level device; cooling coil; No. 81835 thermoregulator and relay unit with cord and plug for connection to standard outlets. For operation from 115 volt 50/60 cycle circuits.....\$275.00

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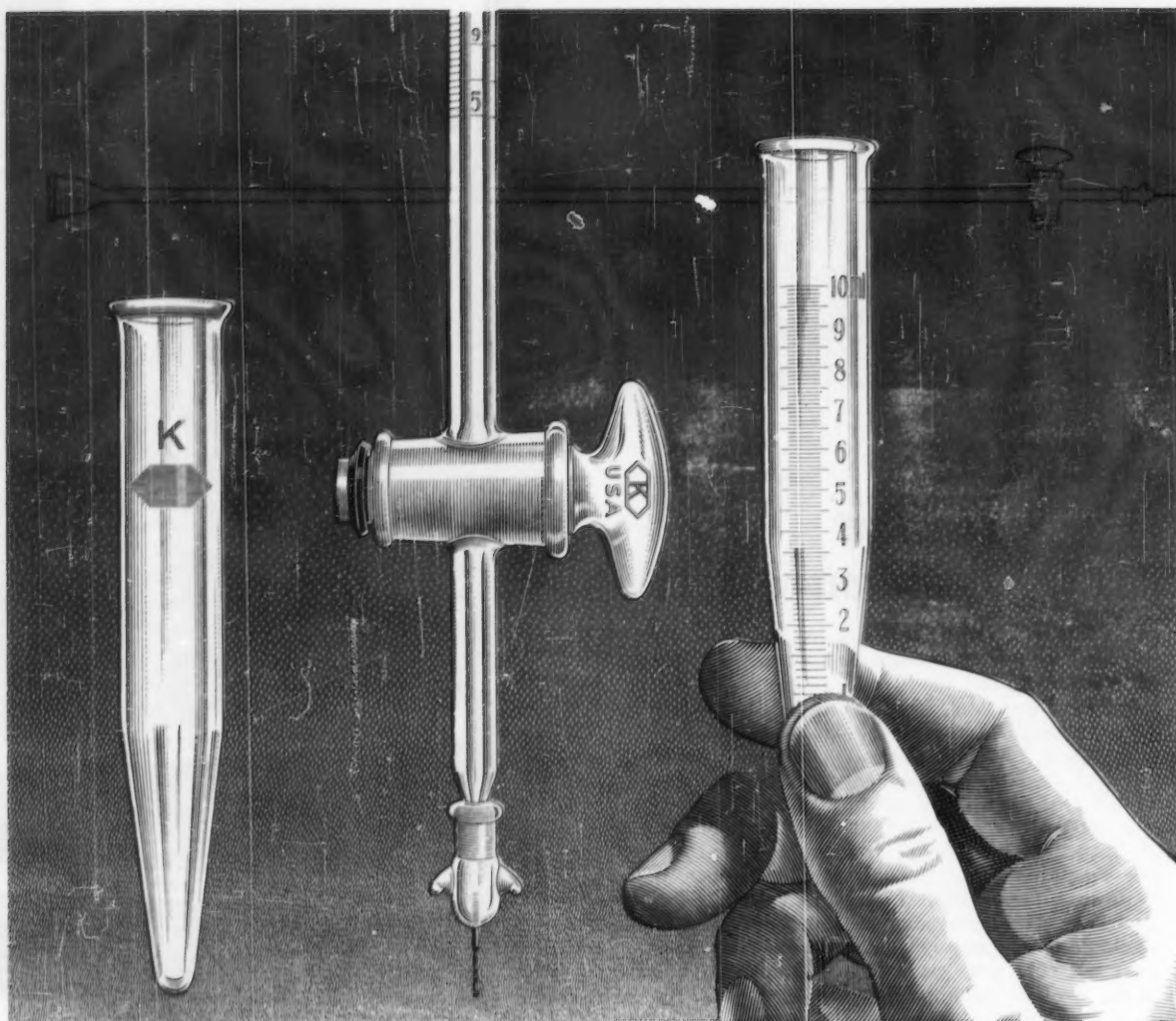
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Kimble Micro-Burette No. 17100 with detachable platinum tip; Kimble Graduated Centrifuge Tube No. 45165.

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K Micro-Burettes: You can deliver drops as fine as .01 ml with the detachable platinum alloy delivery tip. The orifice is gauged to control delivery speed and deliver contents accurately. The tip is constructed so that clogging of the metal tube by dirt and grease is minimized. Being detachable, the tip is easily cleaned. They are attached to the Burette by means of an interchangeable ground joint of the same size as stand-

ard hypodermic syringes. Standard hypodermic needles may be used with this Burette. Burettes with conventional sealed-on glass tips are also available.

Graduated Centrifuge Tubes: They are made from tubing having heavy, even walls. The tops are finished with a machine tooled reinforcing bead. Outside diameters of bodies, tapers and bottoms are carefully controlled to fit holders. Lengths are held within close limits to prevent breakage from hitting against centrifuge heads.

All burettes and tubes are thoroughly annealed to increase mechanical strength. Graduation lines are fine and sharp with fused-in permanent opaque color to permit easy and precise reading. Every burette and graduated centrifuge tube is individually retested for accuracy.

There is a Kimble glassware item available to fill every laboratory need. Your laboratory supply dealer is ready with complete information. Or write Kimble Glass Company, subsidiary of Owens-Illinois, Toledo 1, Ohio.

KIMBLE LABORATORY GLASSWARE

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GENERAL OFFICES • TOLEDO 1, OHIO

(Continued from page 87)

Microspectrophotometer—Fast, sensitive instrument for analysis of solutions in both micro and macro quantities.

Jarrell-Ash Co., 26 Farwell St., Newtonville, Mass.

Spectrometer—A new direct-reading spectrometer designed to provide unusual speed, precision, and versatility.

Jarrell-Ash Co., 26 Farwell St., Newtonville, Mass.

pH Control—Four-page process data sheet offers suggestions on measurement and control of the pH of cooling tower water, and describes equipment for this application.

Leeds & Northrup Co., 444 North 16th St., Philadelphia 30, Pa.

Daylight Intensity—A new two-page Data Sheet E-ND46(2) describes the "Speedomax" Daylight Illuminometer Recorder and the applications of this instrument in the fields of agricultural research, power distribution, weather exposure testing, and air pollution.

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Porous Metal Data—Performance and application data for stainless steel and other metals with controlled porosity for application in the petroleum, chemical, electronic, food, and pharmaceutical industries are available now in a new 45-page brochure.

Micro Metallic Corp., 30 Sea Cliff Ave., Glen Cove, N. Y.

Instrumentation—The fourth-quarter issue of this publication features a walk-in test chamber that can artificially reproduce temperature, humidity, and altitude conditions found anywhere in the world, and a pulp bleach plant that is operated by one man from a "brain center."

Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Ave., Philadelphia 44, Pa.

Servo Analyzer—Analysis of servo-mechanisms and process equipment, using frequency response techniques, is now speeded by the Brown Servo Analyzer, an automatic transfer-function measuring and plotting system. Bulletin 1170 describes and illustrates the components and operation of the versatile instruments.

Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Ave., Philadelphia 44, Pa.

Extended Range Recorder—Five successive suppression steps increase readability by automatically changing the range. This extension of the range increases the effective lengths of the scale and slidewire to almost five times (11 to 51 in.) that of a single range instrument having the same range. Data Sheet 10.0-18 describes the new Brown Elektronik Extended Range Recorder.

Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Ave., Philadelphia 44, Pa.

Portable Magnetic Particle Test Unit—A new eight-page booklet which describes the latest and most economical method for checking ferrous metal objects for surface discontinuities.

North American Philips Co., Mount Vernon Div., 750 S. Fulton Ave., Mount Vernon, N. Y.

(Continued on page 94)



Wilson "Rockwell"* Hardness Testers

New Motorized
WILSON "ROCKWELL"*
Hardness Tester with
SET-O-MATIC* Gauge



Y MODEL
MOTOR-OPERATED

SET-O-MATIC* DIAL GAUGE

Eliminates human error. Operator merely applies minor load and taps depressor bar. No setting of dial to zero.

OTHER FEATURES

- Major load applied under dash pot control
- Major load removed by motor
- Illuminated Dial Gauge
- Illuminated Penetrator

Eliminates Operations... Increases Tests per Hour

All you have to do with the Model Y WILSON "ROCKWELL" Motorized Hardness Tester is apply the minor load and tap the major load depressor bar. The machine does everything else automatically. The cycle of Major Load operation may be less than 2 seconds.

This speed of test means great savings in time which will reduce your hardness testing costs. Yet it is done to Wilson's high standard of accuracy.

The utter simplicity of setting the SET-O-MATIC* dial gauge eliminates human error. The operator does not have to set the dial. The large pointer is automatically brought to "SET" position when the minor load is applied.

The Model Y Motorized WILSON "ROCKWELL" Hardness Tester is in production and orders are being accepted for early delivery. Write today for descriptive literature and prices.



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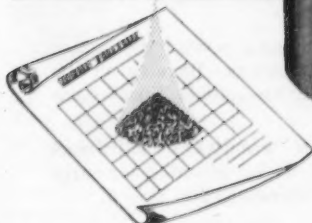


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by well known metal producer—must have thorough knowledge of electro-chemistry for development work on electrodeposition and corrosion protection by means of metallic coating systems. Work involves some travel and liaison with cooperating laboratories and plants. Applicant must be energetic, cooperative and have sound technical ability. Should have practical experience in plating. Submit complete resume of education and experience to Box No. 52, ASTM BULLETIN, 1916 Race Street, Philadelphia 3, Pa.

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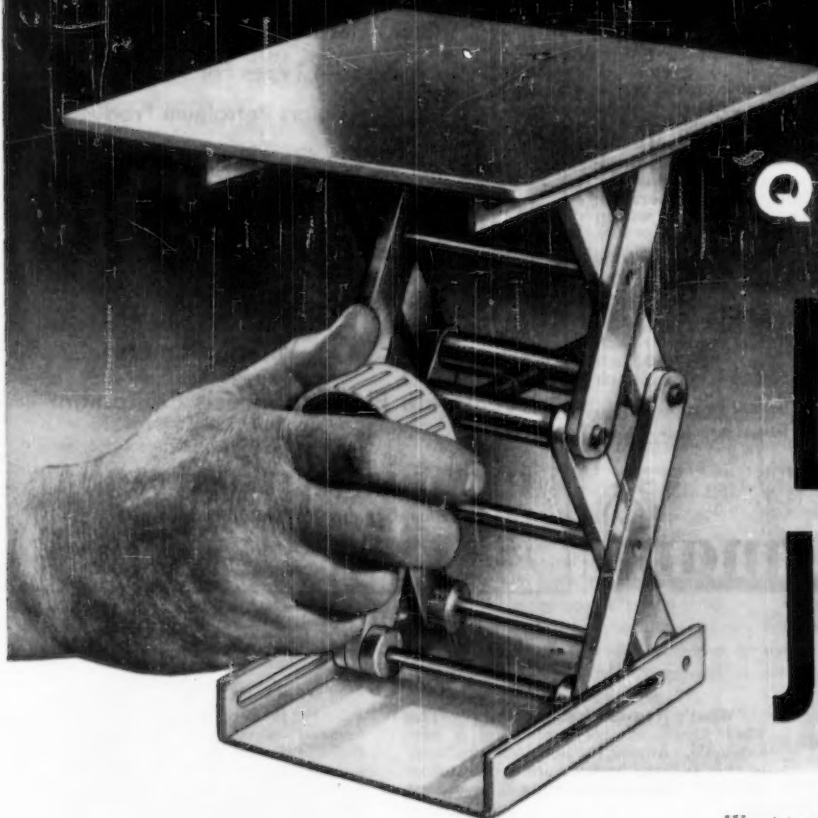
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Homer City, Pa.

CALENDAR OF OTHER SOCIETIES' MEETINGS

- January 31–February 4, 1955—**American Society for Testing Materials**, Committee Week, Netherland-Plaza Hotel, Cincinnati, Ohio.
- February 7–9—**National Crushed Stone Assn.**, Annual Convention, Netherland-Plaza Hotel, Cincinnati, Ohio.
- February 8–9—**Midwest Welding Conference**, Armour Research Foundation, Chicago, Ill.
- February 8–10—**Society of the Plastics Industry, Inc.**, Annual SPI Reinforced Plastics Div. Conf., Hotel Statler, Los Angeles, Calif.
- February 14–17—**American Institute of Mining and Metallurgical Engineers**, Annual Meeting, Conrad Hilton Hotel, Chicago, Ill.
- February 14–17—**Industrial Ventilation Congress**, 14th Annual Meeting, Michigan State College, East Lansing, Mich.
- February 18–19—**National Society of Professional Engineers**, Spring Meeting, Barringer Hotel, Charlotte, N. C.
- February 21–24—**American Concrete Institute**, Annual Meeting, Hotel Schroeder, Milwaukee, Wis.
- February 21–24—**Technical Association of the Pulp and Paper Industry**, Commodore Hotel, New York, N. Y.
- February 22–23—**Society of Plastics of Canada, Inc.**, Annual SPI Canadian Conference, Hotel London, London, Ont., Canada.
- February 28–March 4—**American Chemical Soc. and Spectroscopy Soc. of Pittsburgh**, William Penn Hotel, Pittsburgh, Pa.
- March 1–3—**American Institute of Electrical Engineers**, Hotel Statler, Los Angeles, Calif.
- March 1–3—**Society of Automotive Engineers, Inc.**, Sheraton-Cadillac Hotel, Detroit, Mich.
- March 1–3—**Western Computer Conference and Exhibit**, Statler Hotel, Los Angeles, Calif.
- March 7–11—**National Assn. of Corrosion Engineers**, 11th Annual Conference Exhibition, Palmer House, Chicago, Ill.
- March 10–11—**Porcelain Enamel Institute**, Pacific Coast Conference, Biltmore Hotel, Los Angeles, Calif.
- March 14–15—**Steel Founders Society of America**, Annual Meeting, Drake Hotel, Chicago, Ill.
- March 14–16—**Society of Automotive Engineers, Inc.**, Meeting and Forum, Netherland-Plaza Hotel, Cincinnati, Ohio.
- March 20–23—**American Institute of Chemical Engineers**, Kentucky Hotel, Louisville, Ky.
- March 28–April 1—**American Society for Metals**, 9th Western Metal Congress & Exposition, Pan-Pacific Auditorium, Los Angeles, Calif.
- March 29–April 7—**American Chemical Society**, 127th National Meeting, Cincinnati, Ohio.
- April 13–15—**Society of the Plastics Industry, Inc.**, SPI Pacific Coast Section Conference, Palm Springs, Calif.
- April 18–21—**American Society of Mechanical Engineers**, Spring Meeting, Baltimore, Md.
- April 19–21—**Canadian Institute of Mining and Metallurgy**, Annual Meeting, Royal York Hotel, Toronto, Canada.
- May 1–4—**American Institute of Chemical Engineers**, Shamrock Hotel, Houston, Texas.
- May 2–5—**The Electrochemical Society, Inc.**, Sheraton-Gibson Hotel, Cincinnati, Ohio.
- May 7–15—**The Society of the Plastics Industry, Inc.**, SPI Annual Meeting and Conference, Cruise on the Queen of Bermuda.
- May 9–12—**American Petroleum Institute**, Div. of Refining Mid-Year Meeting, Jefferson Hotel, St. Louis, Mo.
- May 10–12—**Metal Powder Assn. Show**, Philadelphia, Pa.
- May 12–13—**Society for Applied Spectroscopy**, Annual Meeting, Hotel New Yorker, New York, N. Y.
- May 16–19—**American Mining Congress**, Coal Show, Public Auditorium, Cleveland, Ohio.
- June 14–17—**American Petroleum Institute**, Mid-Year Conference of Standardization Comm., Brown Palace Hotel, Denver, Colo.
- June 20–23—**The American Society of Mechanical Engineers**, Semi-Annual Meeting, Statler Hotel, Boston, Mass.
- June 21–24—**Institute of Aeronautical Sciences**, Jt. Meeting with Royal Aeronautical Soc. of Great Britain, 5th International Aeronautical Conference, IAS Building, 7660 Beverly Blvd., Los Angeles, Calif.
- June 20–24—**American Society for Engineering Education**, Annual Meeting, Pennsylvania State University, State College, Pa.
- June 26–July 1—**American Society for Testing Materials**, Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

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Want to simplify your precision set-ups
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The new Cenco-Lerner Lab-Jack is an all-purpose, general utility support that is quickly adjustable through an elevation range of about 7 inches. Its smooth, fast operation makes it particularly useful in isotope research where precision set-ups are required and it offers worthwhile advantages when used for supporting hot plates, oil baths, large Dewar flasks, ground-joint glassware, receivers, etc.

The Lab-Jack is made of stainless steel and aluminum with large plastics control knob. Top plate is $5\frac{1}{2}$ " x $4\frac{3}{4}$ ". Included also is a support rod and an 8" x 8" auxiliary top plate for use when a larger area is required.

Make a note now to include No. 19089 Lab-Jack on your next order.



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For the determination of the kinematic viscosity of any true viscous liquid, such as petroleum products or lubricants.

See: American Society for Testing Materials.
ASTM Designation: D 445-46 T

This capillary-type viscosimeter measures viscosity—under proper manipulation—with an error not greater than $\pm 0.1\%$, when used at efflux times of 80-1000 seconds, or preferably 100-700 seconds. The smallest listed capillary is used for light fuel oil or kerosene, the others for lubricating oils. The temperature of the bath should be controlled within $\pm 0.02^\circ \text{F}$.

Available in all capillary sizes as called for by the ASTM—calibrated or uncalibrated.

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(Continued from page 91)

Relay Control Box—The features and applications of a newly redesigned electronic relay control box when used as a means of handling substantial power loads with very minute current over the contacts of regulating devices are described in *Data Sheet No. 11493*.

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Dryer—This new dryer is equipped for tray drying, or for pole, roll, or plate drying, as desired. All gages, valves, control and recording instruments and charts are mounted on the face of the dryer to make it an integrated, self-contained unit. Write for *Bulletin No. 204*.

G. Sargent's Sons Corp., Graniteville, Mass.

Filter Paper—A new six-page technical bulletin covering the complete current line of Munktells Filtering Papers is now available. The bulletin contains a specification sheet on the various grades of filter papers, including one section devoted to new papers designed for chromatographic and electrophoretic use.

Dept. ASTM, E. H. Sargent & Co., 4647 W. Foster Ave., Chicago 30, Ill.

Polyethylene Laboratory Items—A new eight-page brochure listing fifty different laboratory items as narrow mouth bottles, beakers, funnels, centrifuge tubes, spigots, and line valves made of polyethylene.

Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

"What's New for the Laboratory"—The 22nd edition of this publication is now available. Among the new items featured in this 16-page booklet are a new micro chemical balance and a low-temperature bath.

Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.

Temperature Cabinets—A new four-page bulletin just released features three types of temperature cabinets for cold and heat requirements with temperature ranges from -200°F to $+300^\circ \text{F}$. Available 1 cu ft to 45 cu ft capacity.

Trop-Arctic Temperature Products, Dept. B-366, 627 S. Mulberry St., Muncie, Ind.

LABORATORY NEWS

Liston-Becker Instrument Co., Inc., Springdale, Conn.—In order to satisfy the increased demand for their Infrared Gas Analyzers, Liston-Becker Instrument Co. announces that ground has been broken for a new wing to their present building.

INSTRUMENT COMPANY NEWS

Bell and Howell, Chicago, Ill.—The Three Dimension Co., division of Bell & Howell, has announced three new executive appointments in the TDC Sales Div.

John F. (Jack) Stewart has been appointed national manager for filmstrip projector sales. Stewart has been Eastern sales representative for TDC since 1951 and previous to joining the company had a wide and varied background in the audio-visual sales field. Wes Summerfield now becomes manager for tape recorder sales. Summerfield previously performed various administrative functions as assistant to the vice-president of sales and advertising. John C. Marken has been named assistant to the vice-president of sales and advertising. Marken, previously sales representative for Chicago and Northern Indiana, succeeds Summerfield.

Liston-Becker Instrument Co., Inc., Springdale, Conn.—Cedric Beebe has joined the staff of the Application Engineering group. Mr. Beebe was formerly in charge of the physical analytical laboratory of the Koppers Co. in Pittsburgh, Pa.

Leeds & Northrup, Philadelphia, Pa.—George W. Tall, Jr., Vice-President and Secretary of Leeds & Northrup Co., was elected a director of the National Association of Manufacturers at its recent annual meeting in New York. Mr. Tall represented SAMA and the Manufacturing Trade Group of the National Industrial Council. He is a director of SAMA and a member of the executive committee of its Recorder-Controller Section.

Leeds & Northrup Co. has been a member of ASTM since 1913 and has held sustaining membership since 1940. Over the years it has taken an active part in ASTM research and committee activities.

Kodak reports to laboratories on:

a new material for the base of our business... a disazostilbeneaminodisulfonate for precision titrimetry... a push button notetaker (in color)

P(polystyrene) B(ase)

The first Kodak film on a base other than cellulose ester is now on regular sale.

Kodalith Ortho PB Film has a .005" base of extruded polystyrene. This material is optically clear and as free from visible blemishes as cellulose ester film had become about the time of the Harding administration. What justifies using this material is the fact that when a pelloid is coated on one side and a photographic emulsion on the other, and then you expose it and put it through everything film goes through in processing, drying, and storage, you find it is about three times as dimensionally stable as cellulose ester film. Furthermore, what little dimensional change has occurred is the same in all directions.

Anybody who has been looking for a high-contrast film that probably won't change dimension by more than 0.02% for a 10% change in relative humidity is invited to purchase a box of Kodalith Ortho PB Film from his Kodak Graphic Arts Dealer.

Waterman's find

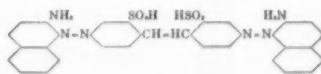


This is how come 4,4'-Bis(2-amino-1-naphthylazo)-2,2'-stilbenedisulfonic Acid Disodium Salt became Eastman Organic Chemical No. 7000.

We had run across several papers by a chemist in the water supply department of a large city who was bothered by the shortcomings of a certain tool of his trade, namely the indicator methyl orange. This has a rather weak color change which occurs perceptibly only at pH 4.6 and is therefore no good for alkalinities below 150 ppm in acid-carbonate titration. In the interests of precision titrimetry, he had felt, it is better to have a pH indicator change from a light color to a dark color as an endpoint is reached, instead of the other way around. In the disazostilbene-

aminodisulfonates he found what he was looking for. A number of dyes of this series gave useful color responses in the broad pH range between 8 and 4. Among the several dyes investigated in this class was an obscure item known to dye men as Hessian Purple N Extra, or more simply, Direct Purple.

Whether he tried to buy it out of a dye catalog and failed, he doesn't say. At any rate, he made some by tetraazotizing 4,4'-Diaminostilbene-2,2'-disulfonic Acid (Eastman T 4613) and coupling with 2-Naphthylamine (Eastman 174) to get his indicator:



This starts from a deep red, shows a first transition at pH 4.0 to a faint mauve, turns emphatically purple at pH 3.8—a long sight more emphatically than methyl orange ever did—and finally goes over to a bluish purple at pH 3.0. Such behavior is reported a lot more useful for the acid titration of sodium carbonate than even that of our *Methyl Orange-Xylene Cyanole Solution* (Eastman A 2216), which was developed back in 1922. We saw our duty clearly before us to spare analysts from doing their own tetraazotizing and coupling. Thus Eastman 7000. It's used as a 0.1% solution.

Is Eastman 7000 of special importance to us? No more so than the rest of the some 3500 organic chemicals we stock. They're all cataloged in our List No. 39 which you may have by writing to Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y. (Division of Eastman Kodak Company).

Close up

You are studying the allergenic properties of varicous substances and don't want to depend on verbal descriptions of your observations. Jot them down on *Kodachrome Film*.

You are investigating erratic behavior of an extrusion press and discover an alarming crack on the hidden side of the base casting. Jot it down on film so that the manufacturer will know exactly what you

are talking about.

"Jot it down" brings a wistful little smile to the lips of those who recognize in that pat term a wee oversimplification of certain problems in lighting, focusing, framing, and camera support that they have encountered in such situations. These skeptics we now confound with this device:



We are not going to suggest that you knock such a simple instrument together yourself because you'd find it takes π times as many hours as you had figured on and then you would discover the first time out that there was an important design point you had overlooked.

Instead we suggest a visit to your Kodak dealer for a look at the new *Kodak Technical Close-Up Outfit*. Heft of it. Note that all you do is put it up to your subject, squeeze, and you get a picture of whatever ear of wheat or lump of carnotite is in the two-sided frame.

The light comes from a walnut-sized flash bulb inside the bag. Since that close it overwhelms even sunlight, exposure, like focus and composition, requires no decision, no onerous cerebration. This always augurs well for the non-professional in photography who nonetheless appreciates good photographs. To use the outfit at 3 feet or at 15 feet or with black-and-white film demands but one or two procedure changes, unambiguously stated on the flash holder. The outfit includes the excellent *Kodak Pony 828 Camera*, the *Kodak B-C Flashholder*, and several other items better seen than read about. The camera is also yours to use without the hardware, of course.

You press the button; it does the rest.
\$62.75.

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This is one of a series of reports on the many products and services with which the Eastman Kodak Company and its divisions are... serving laboratories everywhere

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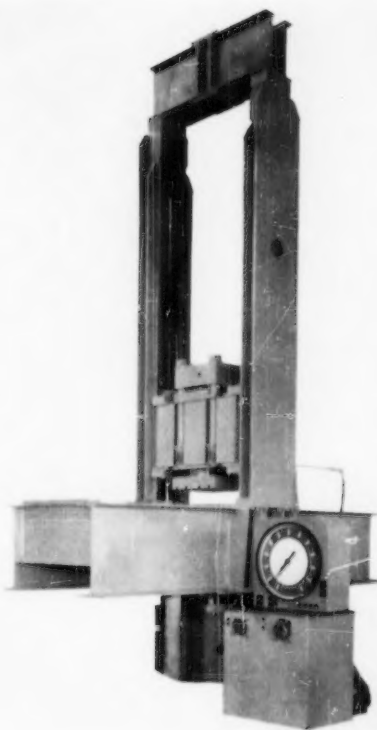
INDEX TO ADVERTISERS

AMERICAN MACHINE AND METALS, INC. RIEHLE TESTING MACHINES DIVISION	Inside Front Cover
ANGEL & CO., INC., H. REEVE	96
ATLAS ELECTRIC DEVICES CO.	81
BALDWIN-LIMA-HAMILTON CORP.	2
CENTRAL SCIENTIFIC CO.	93
EASTMAN KODAK CO.	95
EBERBACH CORP.	80
FISH-SCHURMAN CORP.	94
FISHER SCIENTIFIC CO.	3
GENERAL RADIO CO.	88
GRIES INDUSTRIES, INC.	4
HOGGSON & PETTIS MFG. CO.	80
KIMBLE GLASS CO.	90
KING REFRIGERATION CO.	85
KLETT MANUFACTURING CO.	94
NATIONAL FORGE & ORDNANCE CO.	81
OLSEN TESTING MACHINE CO. TINIUS	Outside Back Cover
ORTH, W. F.	83
PERKINS & SON, INC., B. F.	83
RIEHLE TESTING MACHINES DIVISION, AMERICAN MACHINE AND METALS, INC.	Inside Front Cover
SARGENT & CO., E. H.	89
SCOTT TESTERS, INC.	87
SYNTRON CO.	92
TAYLOR INSTRUMENT COS.	82
TECHNICAL OPERATIONS INC.	89
THOMAS CO., ARTHUR H.	83
THWING-ALBERT INSTRUMENT CO.	84
WILSON MECHANICAL INSTRUMENT DIV., AMERICAN CHAIN AND CABLE	91
YOUNG TESTING MACHINE CO.	Inside Back Cover
PROFESSIONAL CARDS	77, 78

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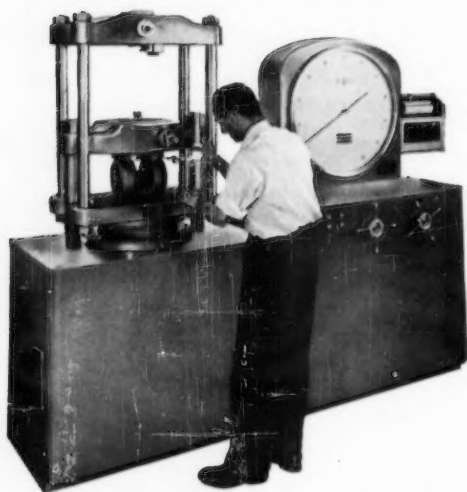


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